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Perceived Environment and the Physical Activity of Workplace Employees

by

Tricia Raylene Prodaniuk ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the

requirements for the degree of Master of Arts

Faculty of Physical Education and Recreation

Edmonton, Alberta
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University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **Perceived Environment and the Physical Activity Behaviour of Workplace Employees** submitted by **Tricia Raylene Prodaniuk** in partial fulfillment of the requirements for the degree of **Master of Arts.**

Ronald Plotnikoff Ph.D.

John Spence Ph.D.

Doug Wilson Ph.D.

September 9, 03

ABSTRACT

Physical inactivity is a serious and complex public health concern with many psychological, biological, sociocultural, and environmental underpinnings. With the environment changing to one that largely promotes sedentary behaviour through modernization and urbanization, physical activity promotion research is moving to multi-level, ecological approaches. The workplace provides an appropriate venue for promoting and researching adult physical activity. This project was therefore undertaken to (1) develop a multi-level global, scale to measure the perceived workplace environment in the context of physical activity, and (2), determine if the global scale was associated with the physical activity behaviour of workplace employees, and if any existing relationship was mediated by self-efficacy and outcome expectations. Results revealed the global scale was marginally related to workplace physical activity, and self-efficacy acted as mediator of the relationship. It is hoped the findings of this project will increase the understanding of ecological approaches for physical activity promotion and research.

Dedication:

I would like to dedicate this thesis to my grandmother Lena Kuzyk. She passed on her belief in the importance of learning through our family as her own children all became teachers and later achieved their Masters degrees in the education field. Lena never had the opportunity to go to University or even high school, as she worked hard nurturing and taking care of her family to make it possible for her own children and grandchildren. She treasured her own grade nine diploma that she kept in her safety deposit box. Lena is very much alive in me, and everyone else in our family. I complete this thesis with her love, and the pride in this accomplishment she is very much a part of.

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CHAPTER I – INTRODUCTION

Overview of the Chapter:

This chapter provides a brief overview of the topics covered in the following chapters of this thesis. The overall rationale and plan of the thesis are provided at the conclusion of this chapter.

Introduction

Within Canada and other industrialized countries, chronic illnesses such as heart disease, cancer, diabetes, and psychological illness comprise the most substantial causes of death and disability significantly burdening health care systems (Grzywacz & Fuqua, 2000). Physical activity behaviour is of interest to researchers in many health and wellness disciplines as regular physical activity has been well established as a powerful mechanism to prevent and treat many debilitating chronic health problems prevalent today (Bauman, Pratt & Sallis, 1998; Breslow, 1996; Dusenbury et al. 1995; Heirich, Foote, Erfurt & Konopka, 1993; Glanz, Marcus, Lewis & Rimer, 1997; Wanzel, 1994).

Our technological-based and knowledge-based environment in North America however, has lead to sedentary lifestyles in an extremely short period of evolutionary time. Indeed, the scientific community has accepted the association between health problems and sedentary behaviour. Yet, despite the beneficial evidence of physical activity, 57% of Canadian adults are not physically active enough to incur health benefits (Canadian Fitness and Lifestyles Research Institute [CFLRI], 2002). Physical inactivity has become a major public health issue on an international scale as highlighted in the recent World Health Report (2002), indicating a need to impact physical activity at the population level.

Health Canada (2001) has described the workplace as an important setting for health promotion research including physical activity. The workplace is a worthy venue to promote physical activity because of the large population involved and the amount of time people spend at work. The majority of Canadian adults spend half of their waking hours or more at work for a significant proportion of their adult lives (Stokols, Pelletier & Fielding, 1996; Health Canada, 2001). According to Statistics Canada (2002), approximately 69% of Albertan adults are workplace employees. In terms of research, the workplace provides a specific environment, established means of communication to employees, and a large captive audience for studies (Shephard, 1996). In the applied area of workplace physical activity promotion, many people could benefit by having a workplace environment that promotes and supports physical activity, making it easier for employees to make physically active choices more often, during or outside of work time (Health Canada).

Within the health promotion domain there can be downstream (e.g., individual focus), midstream (e.g. individuals and specific settings), and upstream (e.g., institutional, policy, and broad environmental focus) initiatives (Marcus & Forsyth, 1999). Most physical activity research has been conducted with a downstream focus; hence most of the existing physical activity behaviour knowledge is at the individual level (Marcus & Forsyth). The downstream approach has had limited success in increasing the physical activity levels of populations, suggesting a greater focus on upstream approaches is warranted. Many researchers (e.g., Gauvin, Levesque & Richard, 2001; Marcus & Forsyth, 1999; McLeroy, Bibeau, Steckler & Glanz, 1988; Polanyi, Frank, Shannon, Sullivan & Lavis, 2000; Sallis & Owen, 2002) recommend more physical activity research needs to be conducted on upstream approaches.

Most *workplace* physical activity interventions in North America have targeted individual level elements such as psychological factors (i.e., motivation, attitudes, and knowledge; Dishman, Oldenburg, O'Neal & Shepard, 1998; Stokols et al. 1996; Heaney & Goldenhar, 1996; Wanzel, 1994). Research has identified many cognitive correlates of physical activity behaviour (Bauman, Sallis, Dzewaltowski & Owen, 2002). Popular social-cognitive theories and models used for such research and interventions include the Transtheoretical Model, the Theory of Planned Behaviour, and Social Cognitive Theory (Culos-Reed, Gyurcsik & Brawley, 2001; Glanz et al. 1997).

These cognitive-based theories share some common theoretical elements (Culos-Reed et al. 2001). Expected benefits and costs of performing a behaviour (outcome expectations), and one's belief they are capable to perform a behaviour to get a desired result (self-efficacy) are examples of common constructs across these established cognitive-based theories (Culos-Reed et al.). These constructs have been operationalized in the physical activity behaviour domain with some promising results (Dishman & Buckworth, 1996; Dzewaltowski, Noble & Shaw, 1990; Sallis & Owen, 2002; Rimal, 2001). Based on a meta-analytical review of the literature, however, *workplace* physical activity interventions have either failed to operationalize such theoretical models and their constructs, or when they have been applied, have at best only been modestly successful at increasing physical activity (Dishman et al. 1998; Shepard, 1996).

The individual-level approach has many limitations such as a need to identify and tailor interventions to specific individuals, and the need to categorize people into groups based on personal attributes that can be incorrectly determined due to measurement errors in assessing such cognitive characteristics. Cognitive-based theories may lack cultural sensitivity making them potentially illegitimate to cultures other than the one to which they were originally developed, and there is a further concern theories haven't evolved to reflect the natural changes in culture over time (Mermelstein & Glanz, 2002). In addition, individual focused interventions usually reach a small target group (McLeroy et al. 1988; Polanyi et al. 2000). Coinciding with these challenges, it is difficult to determine when and why a cognitive-based physical activity intervention is successful (Baranowski, Andersen & Carmack, 1998). Thus, it is not surprising such theories are often incorrectly utilized, are not very successful, or are simply not employed at all in workplace physical activity research and interventions (Dishman et al. 1998; Shepard, 1996).

There have been recent calls for more exploration to examine the workplace environment and its potential effects on physical activity levels of employees using ecological perspectives (Bauman, Pratt & Sallis, 1998; Crump, et al. 1996; Dishman et al. 1998; Dusenbury et al. 1995; Heirich et al. 1993; Gauvin, Levesque & Richard, 2001; Heaney & Goldenhar, 1996; Green, Potvin & Richard, 1996; Polanyi et al. 2001; Stokols et al. 1996; Wanzel, 1994). Ecological approaches for physical activity promotion focus on multiple levels of the environment (e.g., social environment, community environment, physical environment) in addition to the individual level. By focussing interventions on the environments of particular settings, all individuals coming in contact with the target environment can potentially be affected by the intervention. Thus, ecological interventions have the potential to reach large groups of people making ecological approaches logical strategies for addressing public health issues such as physical inactivity.

Although multi-level, environmental physical activity interventions show conceptual promise (Duncan, Duncan, Stryker & Chaumeton, 2002; Giles-Corti & Donovan, 2002; Humpel, Owen & Leslie, 2002) research in this area is relatively dearth as compared to research assessing cognitive correlates of physical activity. Further, a significant limitation in this domain is a lack of published, validated measurement instruments (Sallis, Johnson, Calfas, Caprosa & Nichols, 1997; Sallis & Owen, 2002; Spence & Lee, 2003). More research is clearly needed to develop measurement tools to assess the multiple levels of ecological models related to workplace physical activity, and to examine the relationships among ecological variables with physical activity (Sallis & Owen).

This project is therefore undertaken to accomplish two main aims in relation to the development of multi-level, ecological approaches for workplace physical activity promotion. The first aim is to develop a global ecological scale based on the recent work of Plotnikoff, Fein, Prodaniuk & Milton (2003) to assess the workplace environment in the context of physical activity in a way that can be incorporated into survey research utilizing large samples. The second aim is to assess the relationships between the global ecological scale (developed as Aim one), and cognitive variables associated with physical activity behaviour in a mediation analysis (Baron & Kenny, 1986).

Overall Rationale for the study

The underlying purpose of this research is to generate findings that will increase understanding of the relationships amongst physical activity correlates. An increased understanding may eventually guide the development of interventions to promote physical activity to the adult population. This study is in response to calls in the literature for more research assessing multi-level environment models in the physical activity domain. There is a lack of validated instruments to assess the multiple levels of the workplace environment in relation to physical activity. Further, there is a limited understanding of multi-level environments and their impact on physical activity behaviour in various settings such as the workplace.

An enhanced understanding of the relationships among environmental factors, psychological factors and physical activity behaviour is needed. There have been recommendations for more mediation analyses to map out the relationships between environment, cognitions and behaviour (Baranowski et al. 1998; Bauman, Sallis, Dzewaltowski & Owen, 2002; Lewis, Marcus, Pate & Dunn, 2002; Sallis & Owen, 2002; Spence & Lee, 2003). Further understanding in this area could assist with the development of ecological models applied to physical activity behaviour, and in turn eventually inform the design of multi-level physical activity interventions.

Plan of the Thesis

This thesis is presented in a mixed paper format as outlined by the Faculty of Graduate Studies and Research along with the Faculty of Physical Education and Recreation, University of Alberta. The second chapter reviews pertinent literature that concludes with the two main aims and research questions addressed in this thesis. Chapter III, which is presented as a research paper, comprises the main study component of the project. The final chapter presents the overall conclusions, the limitations of the study, future directions for research, and recommendations for practice and policy. Following the four main chapters, two appendices are presented containing: (1) a detailed outline of the methods (Appendix A); and (2), study instruments, consent forms, and information letters (Appendix B).

Operational Terms:

Six ecological environment levels from a Workplace Physical Activity Assessment Tool (Plotnikoff, Fein, Prodaniuk & Milton, 2003) are utilized in this study. The levels and their content areas include:

1. individual level - individual factors such as fitness level, skills, knowledge, confidence, age, and gender of employees;
2. social level - corporate culture, social relationships, peer, boss, family influence
3. community level - how the organization interacts or partners with other organizations, community-based programs or government bodies;
4. organizational level - infrastructure, leadership, and desire of the organization to promote physical activity, how the organization is structured;
5. policy level - the organization's and government's policies regarding physical activity; and
6. physical environment level - the physical environment of the workplace including the buildings, workplace grounds, and surrounding area

References

Baranowski, T., Anderson, C., Carmack, C. (1998). Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *Preventive Medicine, 15,* 266-297.

Baron, R. M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bauman, A., Pratt, M., Sallis, J., F. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine 15,* 379-395.

Bauman, A., Sallis, J. F., Dzewaltowski, D. A. & Owen, N. (2002). Toward a better understanding of the influences of physical activity. The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine, 23,* 5-14.

Crump, C. E., Earp, J. A. L., Kozma, C. M., & Hertz Picciotto, I. (1996). Effect of organization-level variables on differential employee participation in 10 federal worksite health promotion programs. *Health Education Quarterly 23*, 204-223.

Culos-Reed. C., Gyurcsik, N. C., Brawley, L. R. (2001). Using theories of motivated behaviour to understand physical activity. (Chapter 27). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M (Eds.) *Handbook of Sport Psychology* (pp. 695-717). New York: John Wiley & Sons, Inc.

Dishman, R. K., & Buckworth, J. (1996). Increasing physical activity: A quantitative synthesis. *Medicine and Science in Sports and Exercise, 28,* 706-719.

Dishman, R. K., Oldenburg, B., O'Neal, H., & Shepard, R. J. (1998). Worksite physical activity interventions. *American Journal of Preventive Medicine, 15* (4). 344-359.

Duncan, S. C., Duncan, T. E., Stryker, L. A., & Chaumeton, N. R. (2002). Neighborhood physical activity opportunity: a multi-level contextual model. *Research Quarterly for Exercise and Sport, 73,* 457-463.

Dusenbury, L., Fridinger, F., Hedlund, S. A., Jeffery, R. W., King, A. C., Provence, S., & Spangler, K. (1995). Environmental and policy approaches to cardiovascular disease prevention through physical activity: issues and opportunities. *Health Education Quarterly. 22,* 499-511.

Gauvin, L., Levesque, L., & Richard, L. (2001). Helping people initiate and maintain a more active lifestyle. A public health framework for physical activity promotion research. (Chapter 28). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M

(Eds.) *Handbook of Sport Psychology* (pp. 718-739). New York: John Wiley & Sons, Inc.

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54,* 1793-1812.

Glanz, K., Lewis, F. M., & Rimer, B. K. (1997). Health behaviour and health education theory, research, and practice. (2nd Ed.) San Francisco, California: Jossey – Bass.

Green, L.W., Potvin, L., & Richard, L. (1996). Ecological foundations of health promotion. *American Journal of Health Promotion, 10,* 270-281.

Grzywacz, J. G., & Fuqua, J. (2000). The social ecology of health: Leverage points and linkages. [Electronic version]. *Behavioral Medicine, 26,* 101-115.

Health Canada. (2001). *Health Canada's business case for active living at work. Trends and impact - the basis for investment decisions.* Retrieved August, 25, 2003, from http://www.hc-sc.gc.ca/hppb/fitness/work/trends_e.html

Heaney, C.A., & Goldenhar, L.M. (1996). Worksite health programs: Working together to advance employee health. *Health Education Quarterly, 23,* 133-136.

Heirich, M. A., Foote, A., Erfurt, J. C., & Konopka, B. (1993). Work-site physical fitness programs: Comparing the impact of different program designs on cardiovascular risks. *Journal of Occupational Medicine, 35,* 510-527.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity: a review. *American Journal of Preventive Medicine, 22,* 188-199.

Lewis, B. A., Marcus, B. H., Pate, R. R. & Dunn, A. L. (2002). Psychosocial mediators of physical activity beahvior among adults and children. *American Journal of Preventive Medicine, 23,* 26-35.

Marcus, B.H., & Forsyth, L.H. (1999). How are we doing with physical activity?, *American Journal of Health Promotion, 14,* 118-124.

Mermelstein, R., & Glanz, K. (2002). Theory or theories? Different theories for different groups? Towards better theories of health behavior theories projects workshop. *Meeting Summary.*

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15,* 351-377.

Plotnikoff, R.C., Fein, A. J., Prodaniuk, T. R., & Milton, L. (2003). Development of an ecological assessment tool for a workplace physical activity program standard. Submitted for publication.

Polanyi, M. F. D., Frank, J. W., Shannon, H. S., Sullivan, T. J., & Lavis, J., N. (2000). Promoting the determinants of good health in the workplace. Poland, B. D., Green, L. W., & Rootman, I. (Eds.) Settings For Health Promotion Linking Theory and Practice. Sage Publications, 139-160.

Rimal, R. N. (2001). Longitudinal influences of knowledge and self-efficacy on exercise behavior: tests of a mutual reinforcement model. *Journal of Health Psychology, 6,* 31-46.

Sallis, J. F., Johnson, M. F., Calfas, K. J., Caparosa, S., & Nichols, J. F. (1997). Assessing perceived physical environmental variables that may influence physical activity. *Research Quarterly for Exercise and Sport, 68,* 345-351.

Sallis, J. F., & Owen, N. (2002). In Glanz, K., Marcus Lewis, F., Rimer, B. K. (Eds.).*Health Behaviour and Health Education.* (3rd Ed.).

Shephard, R.J. (1996). Worksite fitness and exercise programs: A review of methodology and health impact. *American Journal of Health Promotion, 10,* 436-452.

Spence, J., Lee, R., (2003). Toward a comprehensive model of physical activity. *Psychology of Sport and Exercise, 4,* 7-24.

Statistics Canada (2002). Labour force, employed, and unemployed, numbers and rates. Retrieved August 25, 2003, from http://www.statcan.ca/english/Pgdb/labor07c.htm

Stokols, D., Pelletier, K. R. & Fielding, J. E. (1996). The ecology of work and health: research and policy directions for the promotion of employee health. *Health Education Quarterly, 23,* 137-158.

Wanzel, R.S. (1994). Decades of worksite fitness programmes. Progress or rhetoric? *Sports Medicine, 158,* 224-230.

World Health Organization (2002). World health report. Reducing risks, promoting health life. Summary report. Retrieved August 25, 2003, from http://www.who.int/whr/en/

CHAPTER II – REVIEW OF THE LITERATURE

Overview of the Chapter

This review chapter of pertinent literature is divided into three main sections. The first section focuses on workplace and physical activity promotion with an overview of sociodemographic and environmental influences of health in the workplace followed by an overview of workplace physical activity promotion. The second section addresses conceptual underpinnings related to this project which include: (1) multi-level ecological frameworks; (2) Social Cognitive Theory; and (3) the Mediation Model. The final section presents issues related to measurement in physical activity research. The chapter concludes with the study's research aims and specific research questions to be addressed.

Environmental and Sociodemographic Influences of Health in the Workplace

Over the past two decades there have been vast changes in the nature and environments of the workplace. Significant technological advances have lead to less heavy manual labour, a reduced amount of manufacturing, and more service sector jobs (Polanyi, Frank, Shannon, Sullivan & Lavis, 2000). For example, in many instances technology has created a work atmosphere dependent on computers and electronic mail, which places many employees at desks for long periods of time (Stokols, Pelletier & Fielding, 1996). Most people no longer have physical demands as part of their job, yet social and psychological demands of jobs are increasingly being linked to poor health of employees (Polanyi et al.; Theorell, 2000).

Canadian Environmentalist David Suzuki contends the technological age that was believed to make the work-week shorter and life easier, has not fulfilled that promise (personal communication, November 18, 2002). Many people work longer hours, and it is more common for individuals to hold more than one part-time job potentially making their combined hours longer then standard full-time (Stokols et al. 1996, Statistics Canada, 2002). There has been a downsizing trend of permanent employees in many large corporations creating more part-time and contract work, resulting in more employee movement, and less job stability (Stokols et al.). Further, the pace of work has been amplified with the use of technology. In many work areas there has been a focus on cost cutting, with workers carrying much of the burden to be more productive often with less resources and/or support. An example of this phenomenon is apparent in primary education and healthcare where continual financial cut-backs have reportedly increased the burden on teachers and healthcare workers in Canada (Geelan, 2002; Health Canada, 2002).

Stress in the workplace has become an important factor contributing to health status in Canadian workers (Wilkins & Beaudet, 1998). In a sample of 9023 employed adults (4709 men and 4314 women), from Statistics Canada's National Population Health Survey (94/95), workers who reported high job strain and job insecurity also reported higher rates of physical and emotional health problems (Wilkins & Beaudet). A growing body of research shows associations between psychological strain, lack of power at work (decisional latitude), and cardiovascular disease (Theorell, 2000). Further, in their review of workplace health promotion programs of 43 studies, Aldana and Pronk concluded high levels of stress had a strong association with absenteeism from work (2001).

The demographic profile of the workforce in Canada currently contains a greater proportion of workers in the older adult group (Shephard, 2000; Stokols et al. 1996). Health problems are more prevalent in older individuals, and people generally become more sedentary as they age, despite the potential health benefits from physical activity in older adulthood (O'Brien Cousins, 1998). Further, older workers may be more likely to suffer from poor self-image in the workplace, especially if they believe their skills are no longer adequate for the quickly changing work environment (i.e., introduction of new technologies), that could cause higher levels of anxiety and/or stress in this employee population (Shephard, 2000).

In adult workers, there is a greater need for childcare, as it is now common for both parents to work fulltime and there are many single parent families (Stokols et al. 1996). Both situations add greater constraints to personal leisure-time (Stokols et al.) as families juggle hectic daily schedules. Indeed, past studies have found a perceived lack of time as the most commonly identified barrier to being physically active in workplace populations (Bowles, Morrow, Leonard, Hawkins & Couzelis, 2002; King, Taylor, Haskell & DeBusk, 1990). Further, childcare also adds greater constraints to disposable income in employee populations (Stokols et al.).

Research has shown that workers with lower financial incomes are less likely to participate in regular physical activity (Desmond, Conrad, Montgomery & Simon, 1993). Evidence exists that Canadians have greater concerns of economic instability due to the changing work environment, changing economy, and the ease at which credit is obtained regardless of financial security (Canadian Council on Social Development [CCSD], 1999). Canadians are continually encouraged to spend, and use credit which has lead to a savings rate in Canada of nearly zero, with the average household debt levels at a record high of more than 100 per cent of annual disposable income (CCSD). A poll conducted by the CCSD (1999) reported that 30 per cent of Canadians believe their savings would sustain them for no more than one month if they lost their job. Feelings of financial insecurity coupled with a need to maintain employment could lead to higher stress levels, and also overshadow the importance of getting regular physical activity.

It is logical to conclude the above sociodemographic and environmental factors are contributing to chronic health problems and physical inactivity of Canadian adults. In summary, low occupational physical activity, working longer hours, a high stress work environment, an aging workforce, less leisure-time, and less disposable income all suggest the need for the promotion of health in the workplace by enhancing and supporting physical activity of workers has never been greater.

Occupational Health and Safety

Health and wellness in the workplace has been, and remains largely governed by the occupational health and safety standards (OH& S) in Canada due to government regulations (Alberta Human Resources, 2002). These health and safety standards have assisted in reducing injuries and some work related diseases of Alberta workers (Alberta Human Resources). In 2001, the risk of injury decreased in almost all industry sectors from 2000 (Alberta Human Resources). Despite this reported success, OH&S standards cannot take full credit for reductions in injury and work related illnesses, as the decline in manual work and increased use of automated equipment have reduced the chances of injury and exposure in many employment areas.

Interestingly, although workplace related injuries have been *decreasing* in Canada, days lost to illness and disability for both males and females appear to be *increasing* across the country. Statistics Canada (2002) reports an increase of approximately one extra day lost to illness or disability in Canada from 1993 to 2001 in full-time employees. This increase in lost days of work may be a result of the growing incidence of chronic health problems in Canada (Grzywacz & Fuqua, 2000), undoubtedly caused by some of the sociodemographic and environmental influences presented in the previous section (Health Canada, 2001). Such findings further demonstrate a need for addressing health in the workplace beyond traditional OH& S standards by promoting physical activity of employees.

Workplace Physical Activity Promotion

Health benefit costs reportedly make up an increasing amount of annual spending in Canadian corporations, and have been rising steadily with a growing proportion being paid by employers (Polanyi et al. 2000). This has left many employers looking for ways to improve employee health and reap economic benefits by promoting healthy behaviours such as physical activity. Further, to be competitive in the job market there has been a growth in health promotion programs offered by workplaces that often include physical activity opportunities (Health Canada, 2001). In Canada however, large firms (500 + employees) are more likely than smaller workplaces to have organization initiated programs, yet one third of Canada's workers are employed by businesses with fewer than fifty employees (Eakin & Weir, 1995). This possibly leaves a large segment of people, without the benefit of any form of workplace support for physical activity.

Research and evaluation purports numerous benefits of workplace physical activity to the employer, and the employee. It has been suggested physical activity programs in the workplace can improve an organization's image, attract higher quality employees, and increase worker morale (Health Canada, 2001; Hollander & Lengermann, 1988; Steinhardt & Carrier, 1989). It is suggested physical activity can create positive relationships between co-workers (Health Canada), which in turn results in a constructive work atmosphere that promotes teamwork. It has been reported there is less worker turnover in workplaces offering physical activity programs (Health Canada), potentially signifying higher employee satisfaction and company loyalty. Most adults spend half of their waking hours or more at work for a significant proportion of their adult lives (Stokols et al. 1996), making satisfaction at work an important element in overall well-being.

If workplace physical activity programs were successful at increasing the physical activity of employees, it could provide health benefits to workers by decreasing the risk of cardiovascular disease, osteoporosis, mental illness, hypertension, back pain, some cancers, and diabetes, and improving stress management (US Department of Health and Human Services, 1996). Two recent reviews have been conducted evaluating the efficacy of workplace physical activity programs for increasing physical activity that draw different conclusions (Dishman et al. 1998; Proper et al. 2003).

Dishman and colleagues (1998) reported that workplace physical activity programs examined in their quantitative-based review (26 studies) had either small or non significant influences on physical activity of employees. Proper et al. (2003) on the other hand, concluded workplace physical activity programs in their qualitative based review

(26 studies) were effective at increasing physical activity. A conclusion of the inconsistent findings between the two studies is the different review methods employed (qualitative vs. quantitative), and the different studies examined (Proper et al.). Proper and colleagues examined workplace programs targeted at increasing physical activity, whereas Dishman and colleague's review focussed on workplace programs with a more structured exercise component (Proper et al.). Despite the underlying reasons for the different findings of both reviews, it can be concluded workplace physical activity initiatives have potential to be effective at increasing physical activity; however the success rate of workplace physical activity programs remains an area of concern.

With the recent shift to the active living or "lifestyle" approach to physical activity from the traditional exercise prescription (Dunn, Andersen & Jakicic, 1998), a new era of physical activity promotion provides great potential for the workplace setting. Active living approaches to workplace physical activity could include physical activity incorporated into the workday by taking the stairs instead of elevators, active commuting, active breaks, and active staff events. The prevalence of such activities has not been thoroughly studied in the workplace context, and is an area requiring further research. There has been some research however, assessing the efficacy of increasing incidental physical activity by stimulating the point of decision for taking the stairs instead of the elevator by displaying signs encouraging stair use (Marshall, Bauman, Patch, Wilson & Chen, 2002; Russel, Dzewaltowski & Ryan, 1999). Such research has shown modest positive effects, and requires further investigation to increase the sustainable impact of such interventions (Marshall et al.). It could be hypothesized more active messages, such as encouraged stair use, would be beneficial in an increasingly sedentary workplace environment.

Individual Level Focus (The dominant theoretical foundation)

Physical activity behaviour intervention research has been dominated by psychology (Dishman et al. 1998; McLeroy et al. 1988). The result of this dominance has been a focus on the individual level in health behaviour research and interventions in the workplace setting (McLeroy et al.). The primary focus of most workplace programs has been on changing individual worker lifestyles with interventions largely targeted at individual characteristics and behaviour (Ainsworth et al. 2001, Dishman et al. 1998; Dusenbury et al. 1995; Fielding et al. 1996; Heaney & Goldenhar, 1996; Hollander & Lengermann, 1988; Polanyi et al. 2000; Sloan, 1987; Wanzel, 1994). Individual interventions usually involve providing activity classes, offering personal training, or providing information to individuals (Gauvin et al. 2001). Sloan (1987) suggests the purpose of such programs in the workplace has primarily been to enhance the organization's performance by modifying the behaviour of individuals.

Limitations to the Individual Level Focus

There are some important limitations and ethical issues surrounding the implementation of interventions in the workplace solely targeting individual lifestyle behaviour. The individual approach takes responsibility away from the organization for providing working conditions that are hindering to health, and instead, places responsibility for health on the individual to counter such conditions through their lifestyle behaviour (Hollander & Lengermann, 1988; Polanyi et al. 2000; Sloan, 1987). This has created interventions that lack needed attention to changing organizational, institutional, and physical environments that may greatly shape behaviour in workplace settings (Dishman et al. 1998; McLeroy et al. 1988). The individual approach does not address the social and economic determinants of health that influence behaviour and health status (Polanyi et al. 2000), as there have been significant differences in health observed across occupations even after lifestyle differences are controlled (Marmot et al. 1991).

An ethical concern coinciding with the individual focus on health is "victim blaming". "Victim blaming" is the term used to describe such an approach where the source of the problem is believed to be inherent in the employee (Sloan, 1987). Rather than seeing people as victims of poor circumstances, one attempts to discover something the person did to bring on their conditions, and therefore, concluding they deserve their health problems (Sloan). Within the workplace, personal and perhaps even embarrassing information (i.e., body mass index, diet, exercise logs, medical history) may be collected for the sake of the individual focussed physical activity program, and/or for screening of employees (Sloan). With such programs, the workplace is also exerting control over employees' behaviour outside of work, as well as within the workplace (Hollander & Lengermann, 1988).

Autonomy, freedom, and control are fundamental needs many people only fulfill during their leisure time (Iso-Ahola & St. Clair, 2000). Motivation to exercise is enhanced by supporting personal freedom and choice (Iso-Ahola & St. Clair), and therefore, exercise prescription and victim blaming may undermine motivation in individual focussed workplace interventions, as people can feel pressured into being active. People may not want to give up their autonomy during their dwindling leisure time, and therefore, be unmotivated to exercise due to the pressure they feel to do so from their workplace.

This phenomenon was illustrated in a study by Linenger, Chesson & Nice, (1991). An intervention was implemented targeting individuals at a military base by having high-level commanders continually stress an expectation of improved physical performance, the importance of a physically fit appearance for future transfer and promotion, and stressing individuals would be held accountable for their own fitness. Other aspects of the intervention included encouraged time off for exercise, an addition of bike paths and marked 1.5 mile runs on the base, and the addition of new gym equipment in exercise facilities (Linenger et al.).

After one year, a slight improvement in 1.5 mile run times was found. More interestingly however, a significant decline in the perceived utility of exercise and the personal importance of fitness was shown. This finding was counter-intuitive to the intervention, which stressed the importance of physical activity and fitness. There was no change in percent body fat, and the percentage of people who burned *less* than 2000 kcal. per week actually increased (Linenger et al. 1991). Although this intervention was targeted beyond the individual level (e.g., the addition of bike paths, etc.), the pressure individuals felt to exercise could have likely been the cause for the intervention's lack of success by taking away people's sense of autonomy in their decision to exercise. Iso-Ahola and St. Clair (2000) have suggested the "interpersonal environment has to support personal choice for exercise more than exercise itself" (p. 138).

Another significant limitation to workplace physical activity interventions found in the literature is a lack of properly implemented theory-based practices (Dishman et al. 1998). Attempts to employ theory-based practices in workplace physical activity interventions have only experienced modest positive results in a meta-analytical review (Dishman et al.). In their review of general physical activity interventions (containing workplaces, schools, communities, etc.) Baranowski, Anderson & Carmack (1998), found in most cases, behavioural or psychosocial theory accounted for 30% or less of the variability in physical activity behaviour, and many published intervention studies actually had little or no influence on physical activity behaviour. These researchers further specify that any behaviour changes reported were small, and it is unclear what aspects of the interventions were responsible for any observed changes in physical activity behaviour (Baranowski et al.). Baranowski and colleagues suggest these findings indicate a need for more applied theoretical research in the workplace physical activity area to increase understanding of such interventions.

Further, much of the literature on workplace physical activity programs describes poor success in attracting or maintaining participation of employees (Dishman et al. 1998; King et al. 1990; Hollander & Lengermann, 1988; Shepard, 1992; Steinhardt & Carrier, 1989; Wanzel, 1994). It has been reported that only 1-2% of Canadians exercise at work (Campell's Canada Survey, 1990). Steinhardt and Carrier have suggested about 20% or less of eligible workers generally participate in workplace fitness programs. Further, a meta-analysis completed by Dishman and colleagues, concluded few people choose the workplace as an environment where they would like to do physical activity. In conclusion, a low participation rate is a large obstacle to the success of physical activity initiatives at the workplace, and further indicates the individual level approach has not been successful at influencing physical activity of the potentially large adult population in the workplace.

Wilson, Plotnikoff & Shore, (2000), concluded that inconsistencies between research and practice were a major limitation in the workplace health promotion field including workplace physical activity promotion. One example of such an inconsistency is the format of exercise programs used frequently in the worksite is formal exercise classes or groups; however this is contrary to what research has indicated as a preference (King et al. 1990; Canadian Fitness and Lifestyle Research Institute [CFLRI], 2002). A study assessing the physical activity preferences of employees working in industry found a strong preference for moderate activities that could be done on their own (King et al.). The CFLRI (2002), investigating physical activity preferences of adults reported formal exercise classes near the lower end of preference (only 7%) compared to walking (69%). Further, Ainsworth et al. (2001), concluded most adults prefer productive physical activity (i.e., yard work and active commuting), as opposed to formal exercise classes.

Conclusions from Section One

Current sociodemographic and environmental circumstances surrounding work and health reveal a need for the promotion of physical activity in the workplace. Traditional workplace health and safety standards fall short of addressing the large public health issue of physical inactivity. Despite a growth in workplace health programs beyond traditional OH&S standards, physical activity initiatives are not common in small Canadian workplaces, where a large percentage of Canadian adults are employed (Eakin

& Weir, 1995) indicating a potentially large group of adults have yet to benefit from any workplace physical activity support.

Two recent reviews examining the efficacy of past workplace physical activity interventions to increase physical activity come to different conclusions (Dishman et al; Proper et al, 2003). Proper and colleagues review focussed on interventions targeting overall physical activity, whereas, Dishman and colleagues reviewed interventions with more structured physical training. Since Proper and colleagues concluded interventions were somewhat successful at increasing general physical activity, it suggests more research should be conducted towards the active living approach to workplace physical activity, as opposed to exercise.

Despite the different conclusions of both reviews, there is consensus in the literature regarding several limitations to current interventions. Workplace physical activity promotion evaluated in the literature has been dominated by psychology, largely focussed at the individual level (Dishman et al. 1998; McLeroy et al. 1988). Psychosocial theories derived from psychology are often not utilized properly, or are not utilized at all, and there has been poor success in attracting and maintaining program participants in workplace physical activity interventions (Dishman et al. 1998; King et al. 1990; Hollander & Lengermann, 1988; Shepard, 1992; Steinhardt & Carrier, 1989; Wanzel, 1994). In addition, the individual focus can lead to victim blaming and take away a sense of autonomy important for motivation to participate in physical activity.

It is clear, a greater understanding of theories applied to physical activity promotion needs to be attained to improve the design and efficacy of interventions. It can be difficult to implement psychosocial theory-based interventions in the workplace due to the vast array of people that may be involved and the unique sociocultural and environmental characteristics of workplaces. Without concurrent changes to the multiple environment levels within the workplace (e.g., individual, social, organizational, policy, community, etc.), employee behaviour changes are short-term (Polanyi et al. 2000). From conclusions of the growing body of literature on workplace physical activity, consensus on a new direction is emerging. Although multi-level ecological approaches are still in their early stages of development in the physical activity promotion domain, they are gaining attention.

The previous section provided a description of sociodemographic and environment factors related to health in the workplace setting, and an overview of research findings in the workplace physical activity domain. The next section presents the theoretical and conceptual underpinnings of the thesis (i.e., ecological models), along with relevant research published in the area.

Ecological Models

Ecological models applied to health behaviours originated from the biological sciences regarding the relationships between organisms and their environments (Stokols, 1992). The complex inter-relations between individuals, their health, and their environment provide the foundation for the design of ecological research and interventions (Gauvin et al. 2001; Green et al. 1996). When utilizing an ecological approach, one is referring to models, frameworks and perspectives rather then specific constructs and variables found in psychosocial theories (Sallis & Owen, 2002). Pertinent variables within ecological models must be identified, and could include constructs or variables from other theories (Plotnikoff, Fein, Prodaniuk & Milton, 2003).

Ecological models applied to the study of human behaviour were derived from a positivist scientific tradition that focuses on the observable, and largely ignores individuals' feelings, thoughts, and perceptions (Green, et al.). Skinner's (1953) work on behaviour has been influential in the development of ecological models applied to the behavioural sciences (Sallis & Owen, 2002). Skinner attempted to unlock the mysteries of human behaviour through the methods of science by studying observable events in the environment and their association with behaviour. Another influential development of ecological models was Lewin's (1951) work on the perceived environment's influence on behaviour (Sallis & Owen).

A unique characteristic of ecological models is a focus on multiple levels of influence. Gauvin and colleagues (2001), describe the foundation of the ecological approach as attempting to simultaneously affect several levels within the hierarchy of a person's environment. Sallis & Owen (2002) refer to the concept of "environment" as an element not including any internal factors within the individual, and only involving the area external to the individual in the positivist tradition. Sallis and Owen (1997) have contended a distinguishing feature separating ecological models from social cognitive theories is the proposition the environment can directly influence behaviour without mediation of cognitive processes. This concept has not been adequately demonstrated with regards to physical activity behaviour, and is an area requiring further research (Spence & Lee, 2003). Spence and Lee further suggest psychological factors, such as self-efficacy, are likely mediators of the environments influence on physical activity behaviour, and should be tested to increase understanding of environmental determinants. Sallis and Owen (2002) concur further research assessing mediating roles of psychological constructs will aid in the development of ecological models.

Sallis and Owen (2002) provide six ecological principles to be considered towards the operationalization of an ecological model heuristic for researchers and practitioners. First, ecological models take into account intrapersonal elements, sociocultural elements, policy, and physical environment influences on behaviour. Second, there are multiple levels of the environment targeted in ecological models such as the physical environment of a workplace, the social environment of a workplace, the surrounding community where the workplace is located, and the workplace policies. Third, environmental influences are behaviour specific (e.g., walking trails will not influence seatbelt use, but will influence physical activity). Fourth, collaboration with professionals from various disciplines is recommended to ensure the multiple levels within ecological models are accounted for adequately. Fifth, evaluation of ecological models is required to increase understanding of how they work. Specifically, evaluations of how multiple levels of the environment may affect potential mediators (i.e., powerful cognitive predictors like self-efficacy) are suggested. Sixth, political actions affect ecological systems by influencing over-arching policies and priorities, and can be influenced by public opinion and collaborated efforts by different groups.

Culos-Reed and others (2001) present how theories can be placed on a developmental continuum moving from hypotheses to conceptual models, concluding with a developed theory supported by ample quality research. Ecological models applied to physical activity behaviour are in their early stages of development (Gauvin et al.

2001; Marcus & Forsyth, 1999), where hypotheses and conceptual models are currently being developed and tested. After a focussed review of empirical research and literature on ecological concepts and physical activity, Spence and Lee (2003) present an ecological model of physical activity (EMPA).

The EMPA is an extension of the work of Bronfenbrenner (1999) and Wachs (1992) hierarchical multi-level environment model of child development that divides the environment into different system levels from the micro to the macro level depending on the breadth and proximity to the individual (Spence & Lee, 2003). The levels of the EMPA include: the most distal levels of physical ecology (i.e., climate) and pressure for Macrossystem change (i.e., urbanization, modernization); Macrosystem Dimensions (i.e., societal values of physical activity); Exosystem Dimensions (i.e., workplace support of physical activity); Mesosystem Dimensions (i.e., family support for physical activity at home); Microsystem Dimensions (i.e., access to high quality facilities, verbal encouragement from spouse); biologic and genetic factors (i.e., heritability); and psychological factors (i.e. self-efficacy, perceived barriers and benefits of physical activity). These levels interact and lead to physical activity behaviour. Figure 1 provides a visual representation and the relationships between the levels of the EMPA.

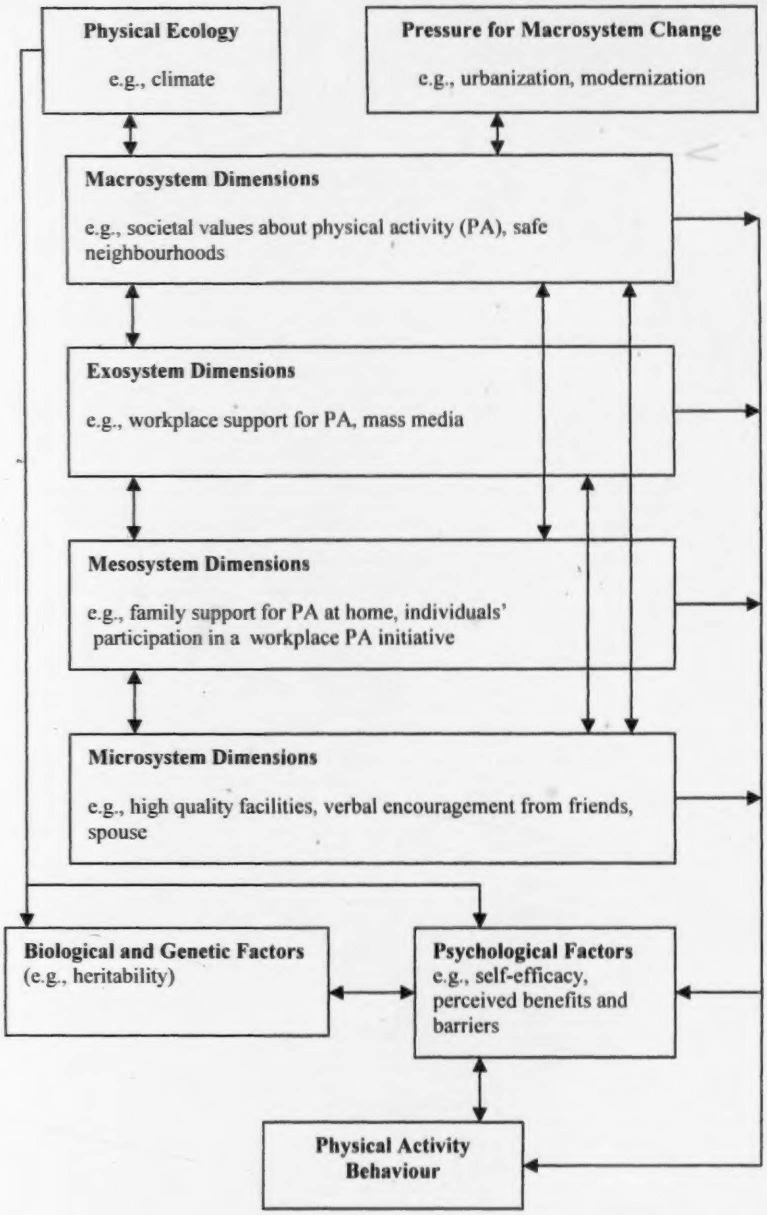
Physical Ecology
e.g., climate
Pressure for Macrosystem Change
e.g., urbanization, modernization
Macrosystem Dimensions
e.g., societal values about physical activity (PA), safe neighbourhoods
Exosystem Dimensions
e.g., workplace support for PA, mass media
Mesosystem Dimensions
e.g., family support for PA at home, individuals' participation in a workplace PA initiative
Microsystem Dimensions
e.g., high quality facilities, verbal encouragement from friends, spouse
Biological and Genetic Factors
(e.g., heritability)
Psychological Factors
e.g., self-efficacy, perceived benefits and barriers
Physical Activity Behaviour

Figure. 1 The ecological model of physical activity (EMPA) (modified from Spence & Lee, 2003, p. 15)

Spence and Lee (2003) suggest the roles of biological factors, higher level mediators (i.e., psychological factors), physical ecology, and direct and indirect influences of the environment are areas of the EMPA requiring more attention and greater acknowledgement in the physical activity research domain.

The EMPA is comprehensive and meant to be utilized as a framework, rather than suggesting a need to examine the model in its entirety in physical activity research (Spence and Lee, 2003). Moreover, research utilizing this framework is at a stage of identifying ecological determinants and correlates rather than determining causal relationships (Spence and Lee). Two important hypotheses suggested by Spence and Lee towards generating greater understanding of the complex relationships occurring within the EMPA are:

1. *The environment exerts a direct effect on physical activity behaviour* (p. 16). This proposition of Sallis and Owen (1997) has not been adequately determined in the physical activity domain.
2. *Psychological factors mediate most of the relationship between extra-individual factors and physical activity* (p. 16). More research is required determining the roles of potential mediators (i.e., self-efficacy) in the environment and physical activity relationship.

Regardless of a need for more research in the area, evidence for the practical application of ecological approaches can be found in the published literature in public health (Breslow, 1996), physical activity (Duncan, Duncan, Stryker & Chaumeton, 2002;

Giles-Corti & Donovan, 2002) and workplace physical activity domains (Crump et al., 1996; Heirich et al. 1993).

Ecological Applications in Public Health

Public health institutions have employed environmental interventions for many years (Ellaway & MacIntyre, 2000; Green et al. 1996). The introduction of water treatment operations, the restriction of smoking areas, and the enriching of white flour are examples of public health interventions using simple ecological concepts (Breslow, 1996). Public health interventions targeting elements of the environment can be very effective as demonstrated by the success of such initiatives like smoking bans and water treatment. Applications of such interventions to public health practices have actually outpaced the research in this domain (Sallis & Owen, 2002). These public health interventions differ from the promotion of physical activity by requiring little, if any effort on the part of individuals to participate in the intervention. For example, the fluoridation of water will positively affect the majority of individuals in the targeted area without any behaviour change required of people. Another example would be smoking bans in public places, which do require behaviour modification on the parts of smokers, yet the law gives them little choice but to conform.

Ecological Testing in Physical Activity Promotion

Research in the physical activity domain utilizing ecological models to date has been largely cross-sectional and descriptive. A growing body of research however, is beginning to provide empirical evidence for the explanatory power of the ecological approach in promoting physical activity.

Duncan and colleagues (2002), utilized a multi-level design to assess the perceptions of neighbourhood factors and physical activity behaviour of 360 adults and 360 children from 56 different neighbourhoods in the US. Study participants were asked questions utilizing Likert-type response options regarding their perceptions of opportunities for physical activity, social cohesion, neighbourhood problems (i.e., crime, noise, safety), and their physical activity behaviour (Duncan et al.). The researchers found perceptions of opportunities for physical activity were significantly associated with perceived social cohesion and neighbourhood problems, and further, perceptions of physical activity opportunities and social cohesion were also associated with physical activity behaviour. Perceptions of multi-level factors differed between neighbourhoods, and were similar within neighbourhoods providing support for the appropriateness of multi-level assessments (Duncan et al.).

Giles-Corti and Donovan (2002) assessed the relationships among individual factors, social environment, and physical environment factors, and recreational physical activity in 1803 adults (18-59 years) living in an Australian metropolitan area. The researchers found physical environment factors had a smaller association to physical activity behaviour then individual and social factors, however, accessible facilities provided an important opportunity to be active. The study findings led the authors to conclude physical environment interventions alone, may not be adequate to increase physical activity, and multi-level interventions targeting individual factors, social environment, and the physical environment would be most efficacious.

Humpel, Owen, and Leslie (2002) conducted a quantitative review of 19 studies that assessed relationships between perceived and objective physical environments (i.e., accessibility to facilities, physical activity opportunities, weather, safety, and aesthetics) and physical activity behaviour. Humpel and colleagues concluded physical environment factors were consistently associated with physical activity behaviour and warranted further research and intervention resources. In addition, a study conducted by Brownson and others, (2000) assessing the influence of walking trail access on physical activity in 12 rural counties in the US, concluded such environmental interventions were beneficial in promoting physical activity in populations with a higher risk of inactivity (i.e., women and lower socioeconomic status).

In the research conducted to date, it appears perceived physical environments do not explain large amounts of variance in physical activity (Craig, Ross, Brownson, Cragg & Dunn, 2002; Fein, Plotnikoff , Wild & Spence, in press; Giles-Corti & Donovan, 2002; Sallis et al. 1997). Fein and colleagues reported the perceived school environment accounted for about 5% of the variance in the energy expenditure of students. Sallis and colleagues found assessments of the perceived neighbourhood environment (i.e., side walks, enjoyable scenery, high crime rates, perceived safety), home environment (i.e., available equipment and supplies to do physical activity), and the presence of facilities on frequently travelled routes, were generally not associated with physical activity. Craig et al. (2002) reported a moderate association between perceived neighbourhood environment variables (i.e., existence of walking routes, convenient destinations, aesthetics, traffic, safety, etc.) with walking to work.

Since most studies examining relationships between the environment and physical activity have been cross-sectional in their designs, environmental causality cannot be determined. Further, any of the reported relationships observed between environmental factors with physical activity, albeit small, could be due to a mediating effect of individual level cognitive predictors such as self-efficacy.

Ecological Applications to Workplace Physical Activity and Health

A review of the literature indicates a need for research taking a multi-level, ecological perspective to workplace physical activity interventions (Bauman et al. 1998; Dishman et al. 1998; Dusenbury et al. 1995; Heirich et al. 1993; Fielding et al. 1996; Heaney & Goldenhar, 1996; Gauvin et al. 2001; Green et al. 1996; Polanyi et al. 2000; Stokols et al. 1996; Wanzel, 1994). Interventions targeting multiple levels of the workplace environment such as the social, policy, organizational, and community level could potentially be more effective than previous interventions focused primarily at the individual level.

Multi-level workplace physical activity interventions show promise in the limited research that has been conducted. A study conducted by Heirich and colleagues (1993) compared three different physical activity interventions in the workplace to test the efficacy of onsite exercise facilities for reducing cardiovascular risk. The first site had a staffed fitness facility, the second site had no facility but provided one-on-one counselling with employees at risk for cardiovascular disease (CVD), and the third site had no facility, but used a multi-level approach of one-on-one counselling, plus organization of the worksite to encourage peer support and mutual physical activities (Heirich et al.). The multi-level intervention site was the most successful at increasing physical activity; the site that only had the facility was the least successful at increasing physical activity and reducing CVD risk (Heirich et al.), demonstrating interventions targeting multiple levels of the workplace may be more effective then single level interventions.

Crump and colleagues (1996) utilized a multi-level model of organizational context (i.e., management support, social environment, and organization resources) and implementation process (i.e., program structure, marketing, and barriers and facilitators) for understanding rates and patterns of employee participation (*n* = 3388) in workplace health programs that included physical activity. The researchers found significant relationships between organizational resource variables in their model (e.g., time off to exercise, onsite facilities) and participation in worksite health programs, especially among minority and lower position level employees. In conclusion, Crump and colleagues found support for the ecological approach for health promotion in the workplace as policy and environmental elements were found to be important for employee participation.

Similar findings were demonstrated in a study in cancer prevention at the workplace. A study conducted by Sorenson, Stoddard, Ockene, Hunt & Youngstrom, 1996, evaluated differences between blue and white collar workers in the determinants of their participation in workplace nutrition, smoking cessation, and carcinogen exposure reduction programs. After controlling for job status and gender, Sorenson and colleagues reported workers who perceived their employer had made changes to limit their exposure to carcinogens, were more likely to participate in smoking cessation and nutrition programs. Further, workers who perceived their employer was willing to make changes to limit employee exposures to carcinogens (i.e., things within management's control), were more likely to participate in workplace health promotion programs (i.e., things under the employees control) (Sorenson et al.). These findings suggest involvement of the workplace at the organizational and policy level may be important for both blue and white collar employee participation in workplace health programs. It also suggests the importance for employees to perceive the involvement of management efforts in health promotion.

In community-based physical activity interventions, the community can be thought of as an ecological system in the promotion of physical activity, with many different elements in the community influencing physical activity behaviour. Ainsworth and colleagues (2001) utilized an ecological approach in a community physical activity research project confirming many diverse institutions in a community can foster physical activity. As such, Ainsworth et al. concluded physical activity promotion should include as many institutions as possible in order to create the most supportive community environment for physical activity. The workplace is an important leverage point for intervention (Grzywacz & Fuqua, 2000), in the larger ecologic community system.

Multi-level workplace physical activity interventions could create an environment with more facilitators and less barriers of physical activity. It has been suggested people who are *not* regular exercisers are more influenced by perceived facilitators and barriers to physical activity (Iso-Ahola & St. Clair, 2000). By targeting interventions at various levels of the workplace environment such as the social environment, the workplace policies, and the organizational commitment to physical activity, the creation of more facilitators and the reduction of barriers for employees to be physically active may be present. Further, an important value of ecological approaches to physical activity is a potential to positively affect a great range of people over a long period of time by focussing on the environments that interact with every individual in the targeted setting (Sallis & Owen, 2002). Ecological-based interventions could very well aid inactive people to become more active, while concurrently reinforcing physical activity in regular exercisers with the same initiatives.

Such interventions could also enhance an active living approach to workplace physical activity. For example, a properly implemented multi-level intervention could create a supportive environment for physical activity thus increasing the physically active choices individuals make on a daily basis. Activities such as increased stair use, active commuting, and active breaks instead of coffee breaks could all be promoted through targeting various levels of the workplace environment. A review conducted by Dunn et al. (1998) examining "lifestyle physical activity interventions" found physical activity incorporated into one's daily lifestyle by informal activities such as taking the stairs, could improve health. Further, studies included in their review found physical activity completed in short bouts (i.e., 10 minutes, three times a day), was as effective in improving fitness and health markers as a continuous 30-minute physical activity bout (Dunn et al.).

An Ecological Workplace Physical Activity Framework

McLeroy and colleagues, (1988), designed an ecological framework for health behaviours by identifying five levels in the environment where practitioners could intervene to promote the desired behaviour. Their five areas of influence include intrapersonal factors, interpersonal processes, institutional factors, community factors, and public policy. The purpose of this framework was to operationalize ecological interventions for health promotion (McLeroy et al.). Sallis and Owen emphasize the important dimension of the physical environment for the context of physical activity behaviour promotion.

Based on the work of McLeroy and colleagues (1988), and Sallis and Owen (1997), a model for workplace physical activity promotion was developed by Plotnikoff, Fein and Milton, (2000) that included six ecological levels of the workplace relevant to physical activity behaviour of employees. The ecological workplace physical activity model includes the *individual level* (i.e., factors in the workplace addressing individual employee characteristics related to physical activity behaviour such as skills, knowledge, confidence, age, and gender), *social level* (i.e., the influence of the corporate culture, social relationships, peer, and boss relationships related to physical activity behaviour of employees), *organizational level* (i.e., infrastructure, leadership, and desire of the workplace to promote physical activity, how the organization is structured), *community level* (i.e., how the workplace interacts, partners with, or utilizes other organizations, community-based resources or government bodies that may foster physical activity behaviour of employees), *policy level* (i.e., the workplaces' policies regarding physical activity behaviour of employees), and *physical environment level* (i.e., the physical environment of the workplace including the buildings, workplace grounds, and surrounding area related to physical activity behaviour of employees; Plotnikoff et al.).

The six environment levels overlap and interact (e.g., changes in the policy environment may affect all other ecological levels in the workplace). Within each level, pertinent literature was used to identify best practices for promoting physical activity in the workplace. These practices were developed and reviewed over the course of a three-year project with input from workplace practitioners, international researchers, and diverse workplaces in Alberta (Plotnikoff, Fein, Prodaniuk, & Milton, 2003). Figure 2. provides a visual representation of the six environment levels within the workplace.

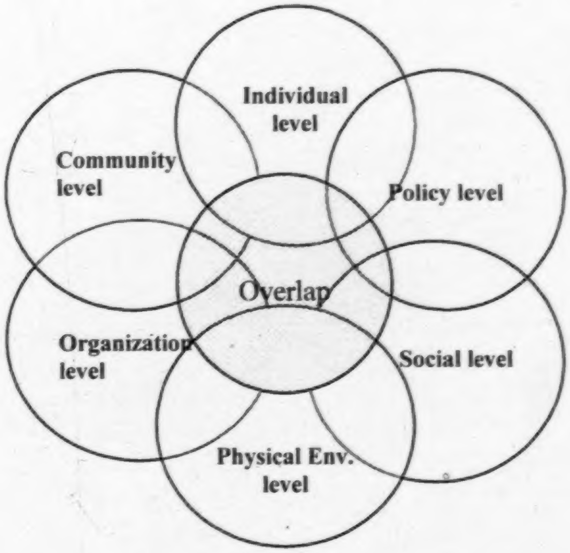
Individual level
Community level
Policy level
Overlap
Organization level
Social level
Physical Env. level

Figure 2. Ecological Workplace Physical Activity Model

(modified from Plotnikoff et al. 2002).

From this ecological workplace physical activity model, an evaluation instrument (Workplace Physical Activity Audit Tool [WPAAT]) was developed for workplaces to assess themselves against identified best practices (Plotnikoff et al. 2003). The WPAAT consists of 45 questions utilizing a dichotomous scaled response option format (e.g., 'yes' and 'no' answers). This instrument builds on previous work of Oldenburg, Sallis, Harris and Owen (2002), who developed a measurement instrument (Checklist of Healthy Environments in the Workplace [CHEW]) designed to evaluate the workplace environment with regards to physical activity and other healthy behaviours, but only included assessment of the physical environment. The WPAAT includes assessment of *multiple* environment levels within the workplace (Plotnikoff et al.).

Challenges of Ecological Frameworks in Physical Activity Research

As already mentioned, in order to operationalize multi-level ecological models, one must not only consider the various environment levels individually, but also the relationships and interactions that occur within and between the environment levels (Stokols, 1996). Assessment of these complex relationships is very challenging. Within complex environmental systems, it may not be possible to account for all variables influencing a particular situation and a particular behaviour making it difficult to map out causal relationships.

An example of the complex interactions can be demonstrated from the EMPA described by Spence and Lee (2003). Their ecological model purports bidirectional relationships occur between factors in different levels of the model that moderate the effects of each other (Spence & Lee). The EMPA further implies the more proximal the influence is to the individual, the more influential effect it will have on behaviour (Spence & Lee). For example, support from family members and friends for physical activity could buffer the detrimental effects of an unsupportive physical environment for physical activity. Thus, researchers must not assume that relationships observed in assessments looking at single levels of an ecological model tell the whole story. Finding a small association between the physical environment and physical activity could be an indication proximal level factors are having an influence on the relationship and vice versa.

Besides the challenging task of acknowledging the complex interactions among levels of ecological models, more work is required on the conceptualization of behaviour specific ecological variables (i.e., factors in the different environment levels) associated with physical activity in various settings such as workplaces (Sallis & Owen 2002; Spence & Lee, 2003). As such, two related limitations to research and interventions using multi-level ecological approaches applied to physical activity behaviour are: (1) a lack of defined valid and reliable measurement scales (Plotnikoff et al. 2003; Sallis & Owen; Spence & Lee); and (2), a deficiency in the understanding and consensus regarding the interrelationships between specific environmental and cognitive determinants of physical activity behaviour (Spence & Lee).

Social Cognitive Theory

Social Cognitive Theory (SCT) (originally referred to as the Social Learning Theory; Bandura, 1986), was developed to describe, understand, and predict behaviour. Bandura is often referred to as the key founder of the theory, yet, other theorists (e.g., Mischel, 1973) have contributed to SCT's development over the years (Baranowski, Perry & Parcel, 1997). SCT asserts behaviour is determined by interactive and changing factors (Sallis, Howell, Hofstetter & Barrington, 1992) and further recognizes an individual's cognitions, as well as, the individual's interaction with their surrounding environment influences one's behaviour (Bandura, 1998; Baranowski et al. 1997; Rimal, 2001).

SCT has provided many useful concepts for understanding behaviour such as self-efficacy, outcome expectations and expectancies, observational learning, reinforcements, self-control, emotional coping responses, environment, and situation (Baranowski et al.). As such, it has been described as one of the most useful of the tested theories for selecting variables to research, and for designing interventions in the physical activity domain (Marcus & Forsyth, 1999). Constructs from SCT have been successfully applied to the prediction of physical activity behaviour in adults (e.g. McAuley, 1992; McAuley, Courneya, Rudolph & Lox, 1994), in community samples (e.g. Sallis et al. 1989), and in the workplace (Hallam & Petosa, 1998; Stutts, 2002).

Much of the physical activity research utilizing SCT employs selected constructs, rather than the entire theory. SCT contains many constructs, some of which are difficult to empirically test, and some researchers argue the theory is too comprehensive to be practical (Baranowski et al. 1997). There is also debate as to whether the theory can explain too many phenomena, and therefore may not be falsifiable (Baranowski et al.). Despite these limitations, SCT has provided valuable insight into physical activity behaviour.

Reciprocal Determinism.

An underlying principle of SCT is a continual interaction occurring amongst the environment, the person, and behaviour referred to as 'reciprocal determinism' (Bandura, 1986; Baranowski et al. 1997). SCT postulates these three components (person, behaviour, & environment) are constantly interacting, and act as determinants of each other (Bandura), with a change in one, invariably affecting the others (Baranowski et al.;

Rimal, 2001). Bandura (1986) maintains that in order to understand behaviour, one must take into consideration the interdependence of these three elements over time, with the exclusion of one not fully describing the causes of behaviour. The triadic relationships between the environment, the person, and behaviour is not normally tested empirically as it is conceptually challenging to do, but rather accepted as an element of the theory (Baranowski et al.).

An example of a reciprocal effect is an individual who begins exercising on a regular basis will alter his environment by adding cues to exercise, such as running shoes in the entry way of the house, and this will in turn influence his behaviour by making him think about exercise when he sees the shoes. By participating in regular exercise, his exercise self-efficacy may increase, reinforcing his behaviour, and in turn, cause him to associate more with other physically active people, thereby influencing his environment, and so on. A schematic (i.e., Figure 3) of the relationship among the three areas of reciprocal determinism and key determinants of physical activity behaviour is displayed below:

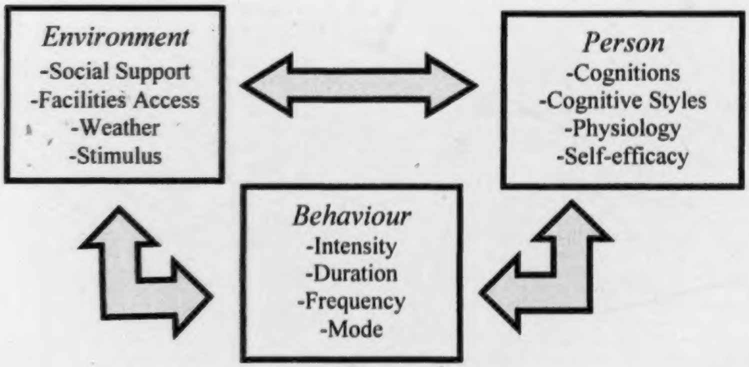
Environment
-Social Support
-Facilities Access
-Weather
-Stimulus
Person
-Cognitions
-Cognitive Styles
-Physiology
-Self-efficacy
Behaviour
-Intensity
-Duration
-Frequency
-Mode

Figure 3. Reciprocal Determinism (Modified from Dzewaltowski, 1994)

Self-efficacy.

People develop beliefs about their capabilities to accomplish certain levels of performance, or do particular activities based on whatever skills, or resources they have (Bandura, 1986). This construct of Social Cognitive Theory has been called self-efficacy, and it refers to the belief one can successfully perform a particular behaviour to produce a desired outcome (Godin & Shepard, 1990). One's self-efficacy is developed in different ways, such as through personal experiences and by watching others (Bandura; Godin & Shepard). Generally, people tend to avoid activities they believe exceed their capabilities. In this case, a low degree of self-efficacy to perform the behaviour with success would discourage the person from engaging in the activity. Having high self-efficacy to perform a particular behaviour increases the likelihood of one to engage in the behaviour, and also increases the effort one uses in order to do the task (Bandura, 1986).

Bandura (1997) has described self-efficacy as a perception of control over one's behaviour in certain situations. If one feels in control of their ability to participate in physical activity, and also has high self-efficacy about performing the behaviour itself, the individual will be more likely to engage in physical activity. Self-efficacy has been shown in many studies to be a strong predictor of physical activity behaviour (e.g. Dzewaltowski, Noble, & Shaw, 1990; Garcia & King, 1991; Plotnikoff et al. 2001), especially at the adoption stage when people are beginning to exercise (McAuley, 1992), and is also considered the strongest construct of social-cognitive theories (Godin & Shepard, 1990; Baranowski et al. 1997). Within the workplace environment, one's belief they have control about whether they can do physical activity under adverse conditions could predict their behaviour. Self-efficacy has been shown to predict physical activity behaviour in workplace populations (Desmond et al. 1993; Hallam & Petosa, 1998; Stutts, 2002).

Outcome expectations.

A person's behaviour creates various consequences that determine the outcomes one experiences as a result of that behaviour (Bandura, 1986). People learn to anticipate outcomes for all of their behaviours, and these anticipated outcomes largely shape the choices people make about their behaviour. Expected outcomes of behaviour make up a construct of SCT called 'outcome expectations'. The general meaning of 'outcome expectations' is what a person expects to happen when they perform a particular behaviour combined with the value they place on that outcome will influence their behaviour (Baranowski et al. 1997).

Baranowski et al. (1997), makes a distinction between two different forms of expected outcomes, 'outcome expectations' and 'outcome expectancies'. 'Outcome expectations' can be either negative or positive; for example, one's 'outcome expectation' of doing physical activity could be they will injure themselves (negative), or that they will sleep better (positive). The value one places on the outcome of the behaviour is the 'outcome expectancy', while the outcome itself is the 'outcome expectation'. Outcome expectations are commonly measured in the form of perceived benefits and barriers in relation to physical activity outcomes, and have demonstrated significant associations to physical activity behaviour (McAuley, Bane & Mihalko, 1995; Sallis et al. 1989; 1992).

Within workplace samples, perceived benefits and barriers to physical activity have had differing levels of association to self-report physical activity. Steinhardt and Dishman (1989) found perceived barriers and outcome expectancy values measured as benefits to physical activity were significantly associated to physical activity in a worker sample. Conversely, Stutts (2002) found perceived benefits and barriers to physical activity were not significantly associated to physical activity in a worker sample using standard multiple regression analyses. Stutts also examined perceived self-efficacy in the same analyses and found it to be the only significant predictor of physical activity in their study. These findings suggest self-efficacy may be a stronger predictor of physical activity then outcome expectations in worker samples.

Social Cognitive Theory and Ecological Models

SCT and ecological models share the perspective of environmental factors being influential in shaping health-promoting behaviour (Bandura, 1986; Humpel et al. 2002; Spence & Lee, 2003). In addition to this similarity however, attempts to define a theoretical basis for ecological models have been challenged by proponents of SCT within the physical activity domain (Sallis & Owen, 1997; Spence & Lee). As mentioned earlier, Sallis & Owen have contended a defining feature of the ecological approach is an acknowledgement of a direct relationship between the environment and behaviour without the mediation of cognitive processes. Bandura (1986) describes this reasoning as 'unidirectional environmental determinism' that does not account for the bi-directional relationship between the environment and the person included in reciprocal determinism.

Further, SCT posits people as being active shapers of their environments rather than passive reactors (Bandura; Maddux, 1993).

As an example Bargh & Gollwitzer (1994), demonstrated enduring goals (i.e., to be polite) can be directly activated by cues in the environment with little cognitive mediation. The researchers conducted a series of studies testing hypotheses of the automotive model of behaviour that purports links can develop between situational and environmental features and behaviour when an individual makes a consistent and frequent choice to fulfill a goal in a certain situation (i.e., saying thank-you). Over time, when the individual enters the situation, their goal directed behaviour will be automatically activated without cognitive mediation (Bargh & Gollwitzer). From Bargh and Gollwitzer's work, it could be hypothesized people with a long term goal to be physically active could be prompted to do physical activity in situations where they have chosen to be active over time, without cognitive mediation. Such findings support a direct relationship between the environment and physical activity behaviour without cognitive mediation, yet there is a lack of consensus of this relationship in the physical activity domain.

Maddux (1997) argues cues in the environment provide more of a 'cue to decision' about whether to do physical activity, rather than a 'cue to action'. For example, seeing your running shoes would make you think about doing physical activity, rather than having you automatically put them on and go for a run without any decision making process. Maddux further suggests physical activity behaviour in particular, is a very cognitive initiated activity as it can involve much preparation and planning in today's busy lifestyle. Further, the work of Bargh and Gollwitzer (1994) seems to apply more to people with enduring goals to be physically active, who have chosen to do physical activity in a certain situation for a long period of time before a direct link between the situation and behaviour will occur. In the promotion of physical activity, it is the inactive people who need to be influenced, and there is evidence inactive people's physical activity behaviour is more dependent on cognitions (i.e., self-efficacy and perceived benefits and barriers; Iso-Ahola & St. Clair, 2000; McAuley, 1992).

The main conceptual difference between SCT and ecological models is the differing view on the existence of a direct effect of the environment on physical activity behaviour (Spence & Lee, 2003). When applying an ecological model to physical activity behaviour, Spence and Lee suggest more research needs to be conducted to map out the relationships between the environment, cognitions and behaviour to determine if direct relationships exist to better inform interventions and research in the physical activity behaviour domain.

The Mediation Model

The Mediation Model provides a way to understand how different variables are related to an outcome variable e.g., physical activity behaviour. A mediator is defined as "an intervening variable that is necessary to complete a cause-effect link between an intervention program and physical activity" (Bauman, Sallis, Dzewaltowski & Owen, 2002, p. 6). It has been hypothesized strong cognitive predictors of physical activity such as self-efficacy, may act as mediators of the relationship between environment variables and physical activity (Spence & Lee, 2003). An assumption of the Mediation Model is an independent variable (i.e., environment variable) influences the mediators (i.e., self-efficacy and outcome expectations) that then predict the dependent variable (i.e., physical activity behaviour) (Baron & Kenny, 1986). This assumption contrasts the direct relationship Sallis and Owen (1997) have purported exists between the environment and behaviour described as a defining feature of ecological models.

The mediation effects of self-efficacy and outcome expectations on the relationship between ecological variables and physical activity behaviour can be tested using a method described by Baron & Kenny, (1986). This analysis tests for the extent to which a potential mediator (social cognitive variable) accounts for the relationship between an independent variable (ecological variable) and a dependent variable (physical activity behaviour) (Baron & Kenny). The hypothesis for this type of analysis would be, ecological variables do not influence physical activity behaviour directly, but influence social cognitive variables in order to impact physical activity behaviour.

There are calls in the physical activity literature for mediation analyses to be conducted in order to guide the development of interventions at higher levels (e.g., physical environment, policy, community levels) of ecological models (Baranowski et al. 1998; Bauman et al. 2002; Lewis, Marcus, Pate & Dunn, 2002; Sallis & Owen, 2002; Spence & Lee, 2003). The mediating variable framework can help identify how theoretical variables influence behaviour change and could advance the development of physical activity interventions (Baranowski, Anderson et al.; Bauman et al.; Lewis et al.).

Lewis and colleagues (2002) recently conducted a review of studies in the physical activity domain that examined potential psychosocial mediators. They concluded few studies were conducted examining mediators, and even less utilized robust statistical methods to assess mediators such as the protocol described by Baron and Kenny (1986). Further, due to the dearth of research examining mediators, Lewis and colleagues recommended researchers in the physical activity domain to examine the effects of different independent variables on potential mediators in order to advance understanding of how physical activity interventions are effective. Self-efficacy and benefits and barriers to physical activity were two of the most commonly examined mediators (Lewis et al.). Self-efficacy had some support as a mediator, and benefits and barriers to physical activity were inconclusive as a mediator. Clearly, more research utilizing the Mediation Model with these constructs would be a valuable contribution to the physical activity domain.

Measurement of the Environment

The following section reviews pertinent topics related to measurement in physical activity research. As previously stated, there is a lack of multi-level environment measurement tools for use in workplace physical activity research. Developmental work in this area however has recently emerged and instruments are beginning to appear in the literature. Oldenburg and others (2002) developed an instrument (i.e., CHEW) mentioned earlier, designed to provide an objective assessment of the physical environment of workplaces in the context of physical activity, healthy eating, and smoking. The CHEW instrument, however, only examines the physical environment of the workplace, providing a checklist of characteristics in the workplace environment pertinent to healthy behaviour. Building on the work of Oldenburg et al., Plotnikoff et al. (2003) developed a multi-level audit tool (WPAAT), (presented on pages 36-38) to assess the workplace environment in the context of physical activity. The WPAAT provides a useful multi-level framework with corresponding environment variables that can be used for both workplace physical activity research and practice (Plotnikoff et al.).

Sallis et al. (1997), suggests perceived environment measures are needed because they are less expensive to implement than objective measures. Additionally, self-report environment measures can be easily included in more studies than objective measures, facilitating the evaluation of environmental influences in a variety of populations and locations (Sallis et al. 1997). Yet, researchers (Sallis et al.; Sallis and Owen, 2002; and Spence and Lee, 2003) maintain that in order to adequately understand the environment's impact on physical activity behaviour, further examination of both perceived and objective measurement strategies should be employed.

There is some evidence suggesting perceived environment measures are congruent with objective environment measures in the physical activity domain. Fein, Plotnikoff, Spence and Wild (2003), conducted a study examining the relationship between objective and subjective measures of a school environment in the context of physical activity. The researchers conducted the objective environment assessment utilizing an audit tool designed for the study, with the subjective assessment being completed in a survey by high school students. A strong correlation was found between the objective measure completed by the research team, and the subjective assessment completed by the students. The authors concluded perceived environment measures are a valid method to assess the environment as a substitute for objective assessments (Fein et al.).

Further, a study described earlier conducted in 56 US neighbourhoods by Duncan et al. (2002), assessed individual perceptions of multiple levels of the neighbourhood environment in the context of physical activity. The researchers found there was agreement of environmental perceptions within neighbourhoods, and differences in environmental perceptions between neighbourhoods providing evidence of the efficacy of perceived multi-level environment assessments (Duncan et al.).

One recent finding of note is in a review of 19 studies (Humpel et al. 2002) assessing the relationships between the perceived and objective physical environment and physical activity. Humpel and colleagues found when environment items were pooled together to create composite variables, relationships between the environment and physical activity behaviour were less likely to be statistically significant. This finding should be taken into consideration when assessing environment and physical activity relationships, and suggests associations at the item level may be more efficacious to identify environment factors pertinent to physical activity behaviour.

Physical Activity Measurement

Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell & Christenson, 1985, p. 126). The different components of physical activity are the duration of the activity bout, the intensity of the activity, and how often the activity is done (frequency). Current recommendations for health suggest a minimum of 30 minutes of moderate intensity physical activity, four times per week is sufficient for health benefits (Health Canada, 2000). The 30 minutes can be accumulated throughout the day in shorter bouts lasting 10 minutes in duration (Health Canada). Further, the lower the intensity of the activity, the longer the accumulated duration needs to be in order to generate health benefits (Health Canada).

There are many different methods used (i.e. observation, calorimetry, physiological markers, mechanical monitors, and surveys) to assess physical activity levels in study participants. Measuring physiological markers through fitness testing is costly and also presents risk to participants, along with liability and ethical issues to researchers. Pedometers provide a more objective physical activity measure, however, besides being costly, pedometers are likely to produce a Hawthorn effect due to participants increased awareness of their physical activity. When studying large samples or populations, most research relies on self-report measures of physical activity obtained through surveys (Caspersen et al. 1985). Reliable and valid self-report physical activity measures are therefore crucial for research to be conducted in the physical activity area.

The Godin Leisure-time Questionnaire (Godin & Shepard, 1985) is a self-report physical activity measure that is commonly utilized in research. The Godin instrument was found to correlate highly to personal electronic motion sensor data in a study comparing the objective physical activity measure to five popular self-report measures (Miller, Freedson & Kline, 1994). The Godin instrument was also tested for validity in an employee sample and was found to correlate strongly with physiological fitness data of Canadian workers (Gionet, & Godin, 1989). These findings support the efficacy of the Godin instrument in providing valid leisure-time physical activity data in adults, and more specifically, Canadian employees.

Gionet and Godin (1989) reported no further explanation of physical activity behaviour measurement could be gained by using more complex physical activity measures. A simple question assessing physical activity of employees was found to be just as valid and reliable as a more elaborate physical activity measure (Gionet & Godin). Schechtman, Barzilai, Rost and Fisher (1991) also assessed the efficacy of measuring physical activity with a single question in a worker sample from a large corporation. They found a strong correlation between their single self-report measure of participation in regular physical activity with body mass index and oxygen capacity in both sexes after adjusting for age (Schechtman et al.). It has further been suggested more complex instruments can lead to greater errors in the data due to participants incorrectly completing the instrument (Miller et al. 1994). Such results provide support for the use of simple measures of self-reported physical activity in large employee samples.

Measurement of Cognitive Constructs

Rensis Likert originally developed the Likert scale in 1932 to measure multidimensional internal states of people such as attitudes, emotions, and orientations (Bernard, 2000). Likert scales are commonly used to assess various constructs in the social sciences (Bernard), and are comprised of questions with a 5-point response option ranging, for example, from ‘strongly agree’ to ‘strongly disagree’. A composite scale of questions attempts to capture the different dimensions of multidimensional constructs. For example, when trying to assess a person’s physical activity self-efficacy, there are different issues associated with self-efficacy. Feeling confident one can do physical activity when they are tired, when the weather is bad, or when they have many other responsibilities, are items that have been measured to assess self-efficacy about engaging in regular physical activity (Plotnikoff, Hotz, Birkett, & Courneya, 2001; Marcus & Owen, 1992).

There are strengths and weaknesses with the assessment of multi-dimensional constructs using composite Likert-type scales, and they should be considered in the interpretation of research findings. When using several items in a composite scale, the researcher is making an assumption all items of the scale are relevant for each individual. With the diversity of individual characteristics in people's interpretations and situations, there is generally a high level of error in the measurement of multi-dimensional cognitive constructs (Tabachnick & Fidell, 1989). Further, grouping items together as one construct actually looses multidimensional predictive effect by creating one new value to represent all items (Rhodes, Plotnikoff & Spence, in press).

A strength of using a composite scale can be parsimony of the statistical analyses. For example, when employing regression analyses to examine the relationships between variables with physical activity behaviour, the more variables added to the analyses increases the likelihood for significant relationships to be found by chance (Norman & Streiner, 1999). Thus, utilizing a composite scale, rather then each item separately in analyses can create fewer variables in the assessment. Further, if each item of a composite scale is highly correlated, multicolinearity will occur in the regression analysis if they are utilized concurrently at the item level, lowering the power of the equation (Tabachnick & Fidell, 1989).

Despite some of the issues of utilizing Likert-type composite scales to assess cognitive constructs, reliability and validity evidence has been shown in the physical activity domain. Outcome expectations measured as expected positive outcomes and barriers to physical activity participation have been shown to be valid and reliable in a sample of college students and a sample of workers (Steinhardt & Dishman, 1989), in addition to Canadian adults (Plotnikoff, Blanchard, Hotz, & Rhodes, 2001). Further, Plotnikoff (2002) and Plotnikoff and colleagues report substantial validity and reliability evidence for a perceived benefits and barriers to physical activity scale, and a physical activity self-efficacy scale in adult populations. In both instances, constructs were measured with Likert-type response options, and assessed for internal consistency as composite scales, with significant associations to reported physical activity behaviour (Steinhardt & Dishman; Plotnikoff; Plotnikoff et al.).

Summary of the Literature Review

The sociocultural and environmental aspects of today's workplaces indicate a need for physical activity promotion. Attempts at promoting physical activity at the workplace however, have not been overly successful with major limitations being low participation rates (Campbell's Canada, 1990; Dishman et al. 1998; Steinhardt & Carrier, 1989), lack of properly implemented theory practices and poorly designed studies (Dishman et al.; Shepard, 1996), and too much emphasis at the individual level (Crump et al. 1996; Dishman et al.; Erfurt et al. 1993; Fielding et al. 1996; Heaney & Goldenhar, 1996; McLeroy et al. 1988; Polanyi et al. 2000; Sloan, 1987; Wanzel, 1994). Thus, there are recommendations for more research utilizing ecological perspectives with workplace physical activity promotion to alleviate the challenges of implementing psychosocial theories to large populations, create supportive workplace environments for physical activity over the long term, and increase the number of individuals exposed to interventions.

Ecological perspectives applied to workplace physical activity are still in an early stage of research (Marcus & Forsyth, 1999), with the development of valid and reliable measurement instruments being a fundamental step (Sallis & Owen, 2002). Plotnikoff and colleagues (2003) have developed an ecological workplace physical activity model and measurement tool (WPAAT) to be utilized in research and practice. Further, Spence and Lee (2003) have described a comprehensive ecological framework (EMPA) for researchers to utilize in the physical activity domain and suggest the following two research hypotheses to assess in order to further the operationalization and uptake of the EMPA: (1) *the environment has a direct influence on physical activity behaviour*; and (2), *psychological variables mediate most of the relationship between the environment and physical activity.*

A suggested defining feature of the ecological approach being a direct relationship between the environment and behaviour without cognitive mediation (Sallis & Owen, 1997) has not been fully accepted in the physical activity domain (Spence & Lee, 2003). Further, ecological approaches have yet to make a theoretical distinction from SCT (Spence & Lee). More understanding is needed with regards to the relationships between the environment (perceived and objective), cognitions, and behaviour (Baranowski et al. 1998; Bauman et al. 2002; Lewis et al. 2002; Sallis & Owen; Sallis et al. 1997; Spence & Lee, 2003). By increasing the knowledge in the area, a greater understanding of how higher level interventions (i.e., policy level, physical environment level, social level, organization level) affect potential mediators (i.e., self-efficacy), thus influencing physical activity behaviour (Baranowski et al.; Bauman et al.; Lewis et al.; Sallis & Owen; Sallis et al.; Spence & Lee).

Despite recommendations for mediation analyses to be conducted in the physical activity promotion domain, there still exists a lack of such assessments in the published literature (Bauman et al. 2002; Lewis et al. 2002). In the limited studies completed, self-efficacy and outcome expectations have been the most common cognitive mediators assessed in the physical activity literature (Lewis et al.). Self-efficacy has received some support as a mediator, with outcome expectations receiving mixed findings (Lewis et al.).

Research Aims

Based on this review of pertinent literature surrounding the ecological approach to physical activity promotion in the workplace, the following two research aims will be addressed in the following chapters.

Research Aim 1

The first study aim is to develop a global ecological scale to assess the perceived workplace environment in the context of physical activity.

Research Aim 2

The second study aim is to determine the relationships between the global ecological scale, cognitive constructs and physical activity behaviour.

Research Question 1: Is a global ecological workplace environment construct associated with physical activity behaviour of workplace employees?

Research Question 2: Are any existing relationships between the global ecological workplace environment construct and physical activity behaviour mediated by self-efficacy and outcome expectations in workplace employees?

References

Ainsworth, B. E., Greaney, M. L., Henderson, K. A., Nef, L. J., & Royce, S. W. (2001). "It takes a village" to promote physical activity: The potential for public park and recreation departments. *Journal of Park and Recreation Administration, 19*, 23-41.

Alberta Human Resources and Employment, (2002) Occupational Injuries and Diseases in Alberta 2001 Summary. Retrieved January 10, 2003, from http://www3.gov.ab.ca/hre/whs/publications/pdf/oid2001.pdf

Aldana, S. G., & Pronk, N. P. (2001). Health promotion programs, modifiable health risks, and employee absenteeism. *Journal of Occupational and Environmental Medicine, 43,* 36-46.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, N.J.: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W.H. Freeman and Company.

Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology and Health, 13,* 623-649.

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *American Journal of Preventive Medicine, 15,* 266-297.

Baranowski, T., Perry, C. L., & Parcel, G. S. (1997). How individuals, environments, and health behavior interact. In Glanz, K., Lewis, F. M., Rimer, B. K. (Eds.), *Health Behaviour and Health Education Theory, Research, and Practice. (2nd Ed.* pp. 153-178). San Francisco, California: Jossey – Bass.

Bargh, J. A., & Gollwitzer, P. M. (1994). Environmental control of goal-directed action: automatic and strategic contingencies between situations and behavior. *Nebraska Symposium on Motivation, 41,* 71-124.

Baron, R. M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bauman, A., Pratt, M., Sallis, J., F. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine 15*, 379-395.

Bauman, A., Sallis, J. F., Dzewaltowski, D. A. & Owen, N. (2002). Toward a better understanding of the influences of physical activity. The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine, 23,* 5-14.

Bernard, H. R. (2000). Scales and scaling. In, *Social Research Methods. Qualitative and Quantitative Approaches* (pp. 285-316). Thousand Oaks: Sage Publications, Inc..

Bowles, H. R., Morrow, J. R., Leonard, B. L., Hawkins, M., & Couzelis, P. M. (2002). The association between physical activity behavior and commonly reported barriers in a worksite populations. *Research Quarterly for Exercise and Sport, 73,* 464-470.

Breslow, L. (1996). Social ecological strategies for promoting healthy lifestyles. *American Journal of Health Promotion, 10*, 253-257.

Bronfenbrenner, U. (1999). Environments in developmental perspective: Theoretical and operational models. In Friedman, L., & Wachs, T. D. (Eds.), *Measuring Environment Across the Life Span Emerging Methods and Concepts* (pp. 3-25). Washington DC: American Psychological Association.

Brownson, R. C, Housemann, R. A., Brown, D. R., Jackson-Thompson, J., King, A. C., Malone, B. R., & Sallis, J. F. (2000). Promoting physical activity in rural communities walking trail access, use and effects. *American Journal of Preventive Medicine, 18,* 235-241.

Campbell's Canada Survey. (1990). *The well being of Canadians*. Ottawa: Canadian Fitness and Lifestyle Research Institute.

Canadian Council on Social Development. (1999). How confident are Canadians about their economic and physical well-being? Retrieved January 23, 2003, from http://www.ccsd.ca/pr/psihle.htm

Canadian Fitness and Lifestyle Research Institute. (2002). How many Canadians are not active enough? Retrieved January 24, 2003, from http://www.cflri.ca/cflri/pa/surveys/2001survey/2001survey.html

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports, 100,* 126-131.

Craig, C.L., Brownson, R. C., Cragg, S. E., & Dunn, A. L. (2002). Exploring the effect of the environment on physical activity. A study examining walking to work. *American Journal of Preventative Medicine, 23,* 36-43.

Crump, C. E., Earp, J. A. L., Kozma, C. M., & Hertz Picciotto, I. (1996). Effect of organization-level variables on differential employee participation in 10 federal worksite health promotion programs. *Health Education Quarterly 23*, 204-223.

Culos-Reed. C., Gyurcsik, N. C., Brawley, L. R. (2001). Using theories of motivated behaviour to understand physical activity. (Chapter 27). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M (Eds.) *Handbook of Sport Psychology* (pp. 695-717). New York: John Wiley & Sons, Inc.

Desmond, A. W., Conrad, K. M., Montgomery, A., & Simon, K. A. (1993). Factors associated with male workers' engagement in physical activity: white collar vs. blue collar workers. *AAOHN Journal, 41,* 73-83.

Dishman, R. K., & Buckworth, J. (1996). Increasing physical activity: A quantitative synthesis. *Medicine and Science in Sports and Exercise, 28,* 706-719.

Dishman, R. K., Oldenburg, B., O'Neal, H., & Shepard, R. J. (1998). Worksite physical activity interventions. *American Journal of Preventive Medicine, 15,* 344-359.

Dun, J.G., Bouffard, M., & Rogers, W. T. (1999). Assessing item content-relevance in sport psychology scale-construction research: Issues and recommendations. *Measurement in Physical Education and Exercise Science, 3,* 15-36.

Duncan, S. C., Duncan, T. E., Stryker, L. A., & Chaumeton, N. R. (2002). Neighborhood physical activity opportunity: a multi-level contextual model. *Research Quarterly for Exercise and Sport, 73,* 457-463.

Dunn, A.L., Andersen, R.E., & Jakicic, J.M. (1998). Lifestyle physical activity interventions history, short- and long-term effects, and recommendations. *American Journal of Preventive Medicine, 15,* 398-410.

Dusenbury, L., Fridinger, F., Hedlund, S. A., Jeffery, R. W., King, A. C., Provence, S., & Spangler, K. (1995). Environmental and policy approaches to cardiovascular disease prevention through physical activity: issues and opportunities. *Health Education Quarterly. 22,* 499-511.

Dzewaltowski, D. A. (1994). Physical activity determinants: A social cognitive approach. *Medicine and Science in Sports and Exercise. 26,* 1395-1399.

Dzewaltowski, D. A., Noble, J. M., & Shaw, J. M. (1990). Physical activity participation: Social cognitive theory versus the theories of reasoned action and planned behavior. *Journal of Sport and Exercise Psychology. 12,* 388-405.

Eakin, J. M., & Weir, N. (1995). Canadian approaches to the promotion of health in small workplaces. *Canadian Journal of Public Health, 86,* 109-113.

Ellaway, A., & Macintyre, S. (2000). Ecological approaches: Rediscovering the role of the physical and social environment. In Berkman, L. F., & Kawachi, I. (Eds). *Social Epidemiology.* (pp. 332-348). New York: Oxford University Press.

Heirich, M. A., Foote, A., Erfurt, J.C., & Konopka, B. (1993). Work-site physical fitness programs: Comparing the impact of different program designs on cardiovascular risks. *Journal of Occupational Medicine, 35*, 510-527.

Fein, A. J., Plotnikoff, R. C., Wild, T. C., & Spence, J. C. (in press). Perceived environmental context and the physical activity in youth. *International Journal of Behavioural Medicine.*

Fein, A. J., Plotnikoff, R. C., Wild, T. C., & Spence, J. C. (2003). An examination of adolescents' perceptions of the school environment related to physical activity. Submitted for publication.

French, S. A, & Jeffery, R. W. (2001). Environmental influences on eating and physical activity. [Electronic version]. *Annual Review of Public Health, 22,* 309-335.

Garcia, A., & King, A., (1991). Predicting long-term adherence to aerobic exercise: A comparison of two models. *Journal of Sport and Exercise Psychology, 13,* 394-410.

Gauvin, L., Levesque, L., & Richard, L. (2001). Helping people initiate and maintain a more active lifestyle. A public health framework for physical activity promotion research. (Chapter 28). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M (Eds.) *Handbook of Sport Psychology* (pp. 718-739). New York: John Wiley & Sons, Inc.

Geelan, D. R. (2002). Falling through the cracks. A summary of what we heard about teaching and learning conditions in Alberta Schools. Edmonton: Alberta Teachers Association. Retrieved August 25, 2003, from http://www.teachers.ab.ca/publications/reports/ Falling_Through_Summary.pdf

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54,* 1793-1812.

Gionet, N. J., & Godin, G. (1989). Self-reported exercise behaviour of employees: A validity study. *Journal of Occupational Medicine, 31,* 969-973.

Glanz, K., Lewis, F. M., & Rimer, B. K. (1997). Health behaviour and health education theory, research, and practice. (2nd Ed.) San Francisco, California: Jossey – Bass.

Godin, G., & Shepard, R. J. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Science, 10,* 141-146.

Godin, G., & Shepard, R. J. (1990). Use of attitude-behaviour models in exercise promotion. *Sports Medicine, 10*, 103-121.

Green, L.W., Potvin, L., & Richard, L. (1996). Ecological foundations of health promotion. *American Journal of Health Promotion, 10*, 270-281.

Grzywacz, J. G., & Fuqua, J. (2000). The social ecology of health: Leverage points and linkages.[Electronic version]. *Behavioral Medicine, 26*, 101-115.

Hallam, J., & Petosa, R. (1998). A worksite intervention to enhance social cognitive theory constructs to promote exercise adherence. *American Journal of Health Promotion, 13*, 4-7.

Hansen, W. B., & McNeal, R. B. (1996). The law of maximum expected potential effect: constraints placed on program effectiveness by mediator relationships. *Health Education Research, 11*, 501-507.

Health Canada (2000). Canada's physical activity guide to healthy active living. Retrieved August 25, 2003, from http://www.hc-sc.gc.ca/hppb/paguide/main.html

Health Canada. (2001). *Health Canada's business case for active living at work. Trends and impact - the basis for investment decisions.* Retrieved August, 25, 2003, from http://www.hc-sc.gc.ca/hppb/fitness/work/trends_e.html

Health Canada (2002). The problem – What is causing the shortage of nursing care? Retrieved July 17, 2003, from http://www.hc-sc.gc.ca/english/for_you/nursing/cnac_report/problem.htm

Heaney, C.A., & Goldenhar, L.M. (1996). Worksite health programs: Working together to advance employee health. *Health Education Quarterly, 23*, 133-136.

Hollander, R. B., & Lengermann, J. J. (1988). Corporate characteristics and worksite health promotion programs: Survey findings from the Fortune 500 companies. *Social Science and Medicine, 26*, 491-501.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity: a review. *American Journal of Preventive Medicine, 22*, 188-199.

Iso-Ahola, S. E., & St. Clair, B. (2000). Toward a theory of exercise motivation. *QUEST,* 52. 131-147.

King, A. C.,Taylor, C., Haskell, W. L., & DeBusk, R. F. (1990). Identifying Strategies for increasing employee physical activity levels: Findings from the Stanford/Lockheed exercise survey. *Health Education Quarterly, 17*, 269-285.

Lewin, K. L. (1951). *Field Theory in Social Science Selected Theoretical Papers.* New York: Harper & Brothers

Lewis, B. A., Marcus, B. H., Pate, R. R. & Dunn, A. L. (2002). Psychosocial mediators of physical activity beahvior among adults and children. *American Journal of Preventive Medicine, 23,* 26-35.

Linenger, J. M., Chesson, C. V., & Nice, D. S. (1991). Physical fitness gains following simple environmental change. *American Journal of Preventive Medicine, 7,* 298-310.

Maddux, J. E. (1993). Social cognitive models of health and exercise behavior: An introduction and review of conceptual issues. *Journal of Applied Sport Psychology, 5,* 116-140.

Marcus, B. H., & Forsyth, L. H. (1999). How are we doing with physical activity? *American Journal of Health Promotion, 14,* 118-124.

Marcus, B. H., & Owen, N. (1992). Motivational readiness, self-efficacy and decision-making for exercise. *Journal of Applied Social Psychology, 22,* 3-16.

Marmot, M. G., Smith, G. D., Stansfeld, S., Patel, C., North, F., Head, J., White, I., Brunner, E., & Feeney, A. (1991). Health inequalities among British civil servants: the Whitehall II study. *The Lancet, 337,* 1378-1393.

Marshall, A. L., Bauman, A. E., Patch, C., Wilson, J., & Chen, J. (2002). Can motivational signs prompt increases in incidental physical activity in an Australian health-care facility? *Health Education Research, 17,* 743-749.

McAuley, E. (1992). The role of efficacy cognitions in the prediction of exercise behavior in middle-aged adults. *Journal Behavioral Medicine, 15,* 65-88.

McAuley, E., Bane, S. M., & Mihalko, S. L. (1995). Exercise in middle-aged adults: Self-efficacy and self-presentational outcomes. *Preventive Medicine, 24,* 319-328.

McAuley, E., Courneya, K. S., Rudolph, D. L, & Lox, C. L. (1994). Enhancing exercise adherence in middle-aged males and females. *Preventive Medicine, 23,* 498-506.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15,* 351-377.

Miller, D. J., Freedson, P. S., & Kline, G. M. (1994). Comparison of activity levels using the Caltrac® accelerometer and five questionnaires. *Medicine and Science in Sports and Exercise, 26,* 376-382.

Mischel, W. (1973). Toward a cognitive social learning reconceptualization of personality. *Psychological Reviews, 80,* 252-283

Norman, G. R., & Streiner, D. L. (1999). *PDQ Statistics* (2nd ed.). Hamilton: B.C Decker Inc.

O'Brien Cousins, S. *Exercise aging & health. Overcoming barriers to an active old age.* Philadelphia, PA. Taylor & Francis, 1998.

Oldenburg, B., Sallis, J. F., Harris, D., & Owen, N. (2002). Checklist of health promotion environments at worksites (CHEW): Development and measurement characteristics. *American Journal of Health Promotion, 16,* 288-299.

Pikora T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science & Medicine, 56,* 1693-1703.

Plotnikoff, R. C. (2002). The development of social-cognitive measures in the exercise domain: Issues and challenges. *Measurement in Physical Education and Exercise Science, 6,* 255-261.

Plotnikoff, R. C., Blanchard, C., Hotz, S. B., & Rhodes, R. (2001). Validation of the decisional balance scales in the exercise domain from the transtheoretical model: a longitudinal test. *Measurement in Physical Education and Exercise Science, 5,* 191-206.

Plotnikoff, R. C., Fein, A., & Milton, L. (2000). An ecological perspective on workplace active living. Executive Summary.

Plotnikoff, R.C., Fein, A. J., Prodaniuk, T. R., & Milton, L. (2003). Development of an ecological assessment tool for a workplace physical activity program standard. Submitted for publication.

Plotnikoff, R. C., Fein, A., & Milton, L. & Prodaniuk, T. (2002). Workplace physical activity program standard and audit tool: An ecological approach. National Health, Work and Wellness Conference, Lake Louise, [Poster Presentation]

Plotnikoff, R. C., Hotz, S. B., Birkett, N. J., & Courneya, K. S., (2001). Exercise and the transtheoretical model: A longitudinal test of a population sample. *Preventive Medicine, 33,* 441-452.

Polanyi, M. F. D., Frank, J. W., Shannon, H. S., Sullivan, T. J., & Lavis, J., N. (2000). Promoting the determinants of good health in the workplace. Poland, B. D., Green, L. W., & Rootman, I. (Eds.) Settings For Health Promotion Linking Theory and Practice. Sage Publications, 139-160.

Proper, K. I., Koning, M., van der Beek, A. J., Hildebrandt, V. H., Bosscher, R. J., & van Mechelen, W. (2003). The effectiveness of worksite physical activity programs on physical activity, physical fitness, and health. *Clinical Journal of Sport Medicine, 13,* 106-117.

Rhodes, R., Plotnikoff, R., & Spence, J. (in press). Creating parsimony at the expense of precision? Conceptual and applied issues of aggregating belief-based constructs in physical activity research. *Health Education Research.*

Richard, L., Potvin, L., Kishchuk, N., Prlic, H. & Green, L. W. (1996). Assessment of the integration of the ecological approach in health promotion programs. *American Journal of Health Promotion, 10,* 318-328.

Rimal, R. N. (2001). Longitudinal influences of knowledge and self-efficacy on exercise behavior: tests of a mutual reinforcement model. *Journal of Health Psychology, 6,* 31-46.

Russel, W. D., Dzewaltowski, D. A., & Ryan, G. J. (1999). The effectiveness of a point-of –decision prompt in deterring sedentary behaviour. *American Journal of Health Promotion, 13,* 257-259.

Sallis, J. F., Hovell, M. F., Hofstetter, C. R., Faucher, P., Elder, J. P., Blanchard, J., Casperson, C. J., Powell, K. E., & Christenson, G. M. (1989). A multivariate study of determinants of vigorous exercise in a community sample. *Preventive Medicine, 18,* 20-34.

Sallis, J. F., Hovell, M. F., Hofstetter, C. R., & Barrinton, E. (1992). Explanation of vigorous physical activity during two years using social learning variables. *Social Science and Medicine, 34,* 25-32.

Sallis, J. F., Johnson, M. F., Calfas, K. J., Caparosa, S., & Nichols, J. F. (1997). Assessing perceived physical environmental variables that may influence physical activity. *Research Quarterly for Exercise and Sport, 68,* 345-351.

Sallis, J.F. & Owen, N., (1997). Ecological models. In Glanz, K., Marcus Lewis, F., Rimer, B. K. (Eds.).*Health Behaviour and Health Education* (pp. 403-424). (2nd Ed.) San Francisco, California: Jossey – Bass.

Sallis, J. F., & Owen, N. (2002). Ecological models. In Glanz, K., Marcus Lewis, F., Rimer, B.K. (Eds.).*Health Behaviour and Health Education.* (3rd Ed.) San Francisco, California: Jossey-Bass.

Schechtman, K.B., Barzilai, B., Rost, K. & Fisher, E. B. (1991). Measuring physical activity with a single question. *American Journal of Public Health, 81,* 771-773.

Shepard, R. J. (1992). A critical analysis of worksite fitness programs and their postulated economic benefits. *Medicine and Science in Sports and Exercise, 24,* 354-370.

Shepard, R. J. (1996). Worksite fitness and exercise programs: a review of methodology and health impact. *American Journal of Health Promotion, 10*, 436-451.

Shepard, R. J. (2000). Worksite health promotion and the older adult. *International Journal of Industrial Ergonomics, 25,* 465-475.

Skinner, B. F. (1953). *Science and human behavior.* New York: The Macmillan Company.

Sloan, R. P. (1987). Workplace health promotion: A commentary on the evolution of a paradigm. *Health Education Quarterly, 14,* 181-194.

Sorenson, G., Stoddard, A., Ockene, J. K., Hunt, M. K. & Youngstrom, R. (1996). Worker participation in an integrated health promotion/health protection program: Results from the wellworks project. *Health Education Quarterly, 23,* 191-203.

Spence, J., Lee, R., (2003). Toward a comprehensive model of physical activity. *Psychology of Sport and Exercise, 4,* 7-24.

Statistics Canada, (2002). CANSIM II, table 279-0029 Days lost due to illness or injury. Retrieved January 24, 2003, from http://www.statcan.ca/english/P

Statistics Canada (2002). Labour force, employed, and unemployed, numbers and rates. Retrieved August 25, 2003, from http://www.statcan.ca/english/Pgdb/labor07c.htm

Steinhardt, M. A. & Carrier, K. M. (1989). Early and continued participation in a work-site health and fitness program. *Research Quarterly for Exercise and Sport, 60,* 117-126.

Steinhardt, M.A. & Dishman, R. K. (1989). Reliability and validity of expected outcomes and barriers for habitual physical activity. *Journal of occupational medicine, 31,* 536-546.

Stokols, D. (1992). The paradox of environmental psychology. *American Psychologist, 10,* 821-837.

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10,* 282-298.

Stokols, D., Pelletier, K. R. & Fielding, J. E. (1996). The ecology of work and health: research and policy directions for the promotion of employee health. *Health Education Quarterly, 23*, 137-158.

Streiner, D. L., & Norman, G. R. (1995). *Health measurement scales. A practical guide to their development and use* (2nd ed.). New York: Oxford University Press.

Stutts, W. C. (2002). Physical activity determinants in adults. Perceived benefits, barriers, and self-efficacy. *AAOHN Journal, 50,* 499-507.

Theorell, T. (2000). Working conditions and health. In Berkman, L. F., & Kawachi, I. (Eds). *Social Epidemiology.* (pp. 95-117). New York: Oxford University Press.

US Department of Health and Human Services. (1996), Physical activity and health: A report of the surgeon general. Atlanta, GA: The Author.

Wachs, T. D. (1992). *The nature of nurture.* Newbury Park: Sage Publications.

Wanzel, R.S. (1994). Decades of worksite fitness programmes. Progress or rhetoric? *Sports Medicine, 158*, 224-230.

Wilkins, K., & Beaudet, M. P. (1998). Work stress and health. *Health Reports, 10,* 47-56.

Wilson, D. R., Plotnikoff, R. C., & Shore, C. L. (2000). Research perspectives on workplace health promotion for the working group on workplace health promotion of the Canadian consortium of health promotion research. Retrieved August 25, 2003, from http://www.utoronto.ca/chp/chp/consort/workplace.pdf

CHAPTER III – PAPER

Running Head: Environment, Cognitions & Physical Activity

Relationships Amongst Perceived Environment, Cognitive Constructs, and Physical Activity Behaviour of Workplace Employees

Abstract

Recent research and commentary contend ecological approaches may be particularly useful for understanding and promoting physical activity participation. Consistent with this argument, the purpose of this study was to (1) develop and examine select psychometric properties of an ecological scale assessing perceptions of the workplace environment in the context of physical activity behaviour, and (2) examine the mediation of key cognitive variables on the relationship between a global, multi-level environment scale and physical activity behaviour. Participants (N = 897) were employees from three large worksites who completed self-report inventories containing measures of self-efficacy, outcome expectations, ecological variables (i.e., individual, social, organizational, community, policy and physical environment levels), and both general leisure-time physical activity and physical activity incorporated into the workday. Results of both bivariate and multiple regression analyses indicated the global ecological scale had a limited association with leisure-time physical activity (R^2adj =.01). Sequential regression analyses slightly supported the association of physical activity incorporated into the workday by the global ecological construct (R^2adj = .04) and the partial mediation of self-efficacy on the relationship between the global ecological construct and workplace physical activity (variance reduced to R^2adj = .02 when self-efficacy was controlled). Implications of the findings for physical activity promotion and future directions for research are discussed.

Introduction

Physical inactivity has become an increasingly profound health issue as it has been linked to many common chronic illnesses such as heart disease, diabetes, cancer, obesity, osteoporosis and psychological illness (US Department of Health and Human Services, 1996). Regular physical activity has been well established as a mechanism to prevent and treat many such chronic health problems, (Bauman, Pratt & Sallis, 1998; Breslow, 1996; Heirich, Foote, Erfurt & Konopka, 1993; Wanzel, 1994), however the majority of Canadian adults (about 57%) are not physically active enough to incur health benefits (Canadian Fitness and Lifestyles Research Institute [CFLRI], 2002). In response to this important issue, researchers are investigating effective ways of promoting physical activity behaviour by furthering our understanding of physical activity behavioural determinants in various settings.

The workplace has been identified as a key setting to promote physical activity by both Canadian and International governments (Autonomous Government of Catalonia, 1996; Health Canada, 2001) due to a large adult population that can be reached by an established means of communication within workplaces (Shephard, 1996). The majority of Canadian adults are in the workforce and spend half of their waking hours in a workplace environment (Health Canada, 2001). However, the modernization of today's workplaces has contributed to physical inactivity, as many workers are now sedentary during working hours (Stokols, Pelletier & Fielding, 1996). Thus, there is a potential for many people to benefit by effective workplace initiatives promoting physical activity during or outside of work time (Health Canada).

Most workplace physical activity interventions have been focussed at the individual level (i.e., employees) such as providing physical activity and health information to employees and targeting psychological factors related to physical activity behaviour (Dishman, Oldenburg, O'Neal & Shepard, 1998; Stokols et al. 1996; Heaney & Goldenhar, 1996; Wanzel, 1994). Expected benefits and costs of performing a behaviour (i.e., outcome expectations), and one's belief they are capable to perform a behaviour to get a desired result (i.e., self-efficacy) are constructs utilized from established cognitive based theories, such as Social Cognitive Theory, to promote physical activity at the individual level (Culos-Reed, Gyruscik & Brawley, 2001). However, based on a meta-analytical review of the literature, workplace physical activity interventions using such theoretical constructs as a basis for intervention have at best only been modestly successful at increasing physical activity (Dishman et al.; Shephard, 1996).

Recent calls have been made to examine the workplace environment and its potential effects on physical activity levels of employees by developing and utilizing ecological models (Bauman, Pratt & Sallis, 1998; Crump et al. 1996; Dishman et al. 1998; Dusenbury et al. 1995; Heirich et al. 1993; Stokols et al. 1996; Heaney & Goldenhar, 1996; Green, Potvin & Richard, 1996; Wanzel, 1994). The essence of ecological models is an emphasis on the environments in which people interact, such as their home environment, work environment, the sociocultural environment, and the climate where they live. Gauvin, Levesque & Richard (2001), describe the foundation of the ecological approach as being an attempt to simultaneously affect several levels of a person's life setting.

As more focus is placed on employing ecological models in physical activity promotion research and interventions, attempts at defining a theoretical basis have begun to emerge. Spence and Lee (2003) developed an ecological model for understanding physical activity behaviour (Ecological Model of Physical Activity [EMPA]). The EMPA provides a comprehensive ecological framework for understanding physical activity; with the authors suggesting specific research hypotheses towards the continued development of ecological approaches in the physical activity domain (see Spence & Lee).

Further, from the work of McLeroy, Bibeau, Steckler and Glanz, (1988), and Sallis and Owen (1997), Plotnikoff, Fein, Prodaniuk, and Milton (2003) developed an ecological workplace physical activity model identifying six overlapping environment levels in the workplace: the *individual level* (i.e., factors in the workplace addressing individual employee characteristics related to physical activity behaviour such as skills, knowledge, confidence, age, and gender), *social level* (i.e., the influence of the corporate culture, social relationships, peer, and boss relationships related to physical activity behaviour of employees), *organizational level* (i.e., infrastructure, leadership, and desire of the workplace to promote physical activity, how the organization is structured), *community level* (i.e., how the workplace interacts, partners with, or utilizes other organizations, community-based resources or government bodies that may foster physical activity behaviour of employees), *policy level* (i.e., the workplaces' policies regarding physical activity behaviour of employees), and *physical environment level.* (i.e., the physical environment of the workplace including the buildings, workplace grounds, and surrounding area related to physical activity behaviour of employees; Plotnikoff et al.).

Additionally, Plotnikoff and colleagues (2003) developed and validated the content of a workplace physical activity audit tool (WPAAT) by identifying elements in each level of the model suggested as best practices in the literature and by stakeholders to promote physical activity in the workplace. The WPAAT was designed for workplaces to evaluate physical activity programs using the workplace physical activity ecological model as a framework (Plotnikoff et al.).

Along with testing behaviour and setting specific models such as the one developed by Plotnikoff et al. (2003), more developmental work is required with ecological theory concepts, as past attempts to define theoretical underpinnings have received some contention by traditional behavioural change theory (Sallis & Owen, 2002; Spence & Lee, 2003). Social Cognitive Theory (SCT; Bandura, 1986) is similar to ecological theory as it shares the perspective that environmental factors can be influential in shaping health-promoting behaviour (Humpel, Owen & Leslie, 2002; Spence & Lee, 2003). Sallis and Owen (1997) however, have argued a defining feature of ecological theory is a direct relationship between the environment and behaviour without cognitive mediation. Bandura (1986) describes this reasoning as ‘unidirectional environmental determinism’ that does not account for the bi-directional relationships he posits that occur between the environment and the person included in SCT (reciprocal determinism). SCT further presumes people are active shapers of their environments rather than passive reactors (Bandura; Maddux, 1993).

There has been research supporting direct relationships between the environment and goal directed behaviours. Bargh and Gollwitzer (1994) conducted a series of studies testing hypotheses of the auto-motive model of behaviour that purports links can develop between situational and environmental features and behaviour when an individual makes a consistent and frequent choice to fulfill a goal in a certain situation (i.e., being polite). Over time, when the individual enters the situation, their goal directed behaviour will be automatically activated without cognitive mediation (Bargh & Gollwitzer). From Bargh and Gollwitzer's work, it could be hypothesized people with a long term goal to be physically active could be prompted to do physical activity in situations where they have continually chosen to be active over time, without cognitive mediation. It could also be hypothesized that the environment could provide cues that promote other behaviours without cognitive mediation that discourage physical activity. For example, in the workplace setting, one may have a goal to be successful at work, and thus when presented with an opportunity to do physical activity such as a break, they choose to talk with an influential person in the office instead, or continue working to appear like a dedicated employee. However, the automotive model has not been tested in the physical activity domain.

Maddux (1997) argues factors in the environment provide a 'cue to decision' about whether to do physical activity, rather than a direct 'cue to action'. For example, seeing your running shoes could provide a cue to decide to engage in physical activity, rather than having you automatically go for a run. Maddux further suggests physical activity behaviour in particular, is a very cognitive initiated activity, as it can involve much preparation and planning in today's busy lifestyle. Physical activity interventions aimed solely on the environment may also instigate internal psychological alterations shaping behaviour change, such as influencing one's self-efficacy about doing physical activity.

In their more recent publication describing ecological concepts, Sallis and Owen (2002), no longer describe the direct relationship between the environment and behaviour as a defining feature of ecological models, but acknowledge the environment can both directly and indirectly, through one's perceptions, influence behaviour. This modified description in part resembles SCT's reciprocal determinism principle (Bandura, 1986). Indeed, some theorists have purported ecological theory is largely a mirror of SCT with multiple levels identified in the environment (Spence & Lee, 2003). Two potential research aims suggested by Spence and Lee to further understanding of ecological models in the physical activity domain are (1) to determine if a direct relationship exists between the environment and physical activity, and (2) to determine if psychological variables mediate most of any relationship observed.

The mediation effects of key cognitive predictors, (i.e., self-efficacy and outcome expectations), can be tested on the relationship between ecological variables and physical activity behaviour using a method described by Baron and Kenny, (1986) as depicted in Figure 1. The Mediation Model tests the extent to which a potential mediator (e.g., psychological variable) accounts for the relationship between an independent variable (ecological variable) and a dependent variable i.e., physical activity behaviour (Baron & Kenny). The hypothesis for this type of analysis would be, once psychological variables are controlled (i.e., self-efficacy and outcome expectations) any relationship between ecological variables and physical activity behaviour would no longer be apparent, or substantially reduced (Baron & Kenny).

INSERT FIGURE 1. ABOUT HERE

There are recent calls in the physical activity literature for mediation analyses to be conducted in order to guide development of ecological physical activity interventions (Baranowski, Anderson & Carmack, 1998; Bauman, Sallis, Dzewaltowski & Owen, 2002; Lewis, Marcus, Pate & Dunn, 2002; Sallis & Owen, 2002; Spence & Lee, 2003). Popular cognitive based theories used in health promotion (i.e., Transtheoretical Model, Health Belief Model, Social Cognitive Theory) do not predict behaviour adequately at higher levels (i.e., environmental, policy, community) of ecological models (Baranowski et al.; Bauman et al.). Further, current theoretical approaches to predict physical activity have been quite limited, at best explaining about 30% of variance in physical activity suggesting more understanding of physical activity determinants is needed (Baranowski et al.; Baranowski et al, 1997). In their review of studies examining potential psychosocial mediators of physical activity, Lewis and colleagues reported a dearth of such research despite calls in the literature for such assessments.

This study therefore had two aims: (1) to develop and assess the psychometric properties of a multi-level global scale to measure the perceived workplace environment; and (2) to determine if the global ecological metric is associated with physical activity behaviour of workplace employees and further, test for the mediation of prominent psychological predictors (self-efficacy and outcome expectations) on any observed relationship between the global ecological metric and physical activity behaviour using a mediation analysis described by Baron & Kenny (1986).

Methods and Results

Aim One: Instrument Development

Phase One - Initial Item Development

The multi-level workplace environment scale was developed based on the ecological workplace physical activity audit tool (WPAAT) developed by Plotnikoff and colleagues, (2003). One question was created for each environment level (i.e., individual, social, organization, policy, community, and physical environment) of the WPAAT to provide a brief, six-item global scale. Each item was formed by modifying the main concept of questions used in each level of the WPAAT, utilizing a 5-point Likert-type response option scale.

The six questions were piloted on a convenience sample of 15 employed adults (18-55 years) comprised of men and women varying in background, and education level (i.e., high school diploma to graduate degree). The 15 individuals were asked about their comprehension of each item, and what thoughts the items provoked. Participants were also encouraged to make any suggestions to make the questions clearer. This information assisted to modify the wording of each item and to ensure each item was comprehensible for the intended research population. Following the initial item development (phase one), the scale was subjected to an expert review (phase two), and test-retest assessment (phase three). The final version of the Perceived Workplace Environment Scale (PWES) presented in Table 1 consisted of six items with five point Likert-type response options.

INSERT TABLE 1. ABOUT HERE

Phase Two – Expert Review

Measures

Item Content Review Form (ICRF).

The ICRF was developed using a description of an Item Content Review Form described by Dunn, Bouffard & Rogers (1999). The ICRF was designed to assess how well each item of the perceived workplace environment scale (PWES) represented the matching content definition for each level of the WPAAT. The instrument employed a 5-point Likert-type scale ranging from "poor representation" (1) to "excellent representation" (5). The ICRF also included a section encouraging written feedback on the measures for further clarification of the assessment, and to aid in improving the measures for future research.

Sample and Procedure.

A list of potential experts was identified through published literature, networks, and public domain information to review the PWES. Three groups of five individuals were obtained from three different contexts as recommended by Dunn, Bouffard & Rogers (1999) to potentially add valuable perspectives to the scale review. A sample of five individuals is the minimum requirement for conducting statistical analyses (Dunn et al.). The first group ($n = 5$) were published researchers from Canada and Australia working in the physical activity and health domain. These individuals were chosen for their research and theoretical expertise. The second group ($n = 5$) was comprised of professional practitioners from Alberta and Ontario with degrees and experience in workplace health and/or physical activity. These individuals were chosen for their practical knowledge in workplace physical activity promotion. The third group ($n = 5$) consisted of full-time employed individuals in Alberta from a variety of different work areas (i.e., health care, education, technology, recreation). These individuals would provide the perspective of employees to this evaluation.

Participants were emailed an information letter, consent form, and ICRF as an attachment. Individuals choosing to participate filled out the ICRF and then emailed it back to the principal investigator. All quantitative data were entered into an SPSS 10 database for analysis. Qualitative comments were summarized into categories for each item, and suggestions compiled to refine the measures for future research.

Analysis and Results.

Six one-way ANOVA analyses were performed (one for each of the items in the ICRF) with the three groups of experts to detect differences between the means of each group. Results revealed no significant differences between the three groups on any of the items (see Table 2) thus no post hoc comparisons were made (Ness Evans, 1998).

INSERT TABLE 2. ABOUT HERE

To further assess the expert review data, responses for all participants were combined ($N = 15$). The descriptive statistics revealed the following results: approximately 70% of participants rated the individual item as a ‘good’ to ‘excellent’ representation of the content definition; approximately 90% of participants rated the social item as ‘good’ to ‘excellent’; approximately 80% rated the organization item as ‘good’ to ‘excellent’; approximately 85% rated the community item as ‘good’ to ‘excellent’; approximately 90% rated the policy item as either ‘very good’ or ‘excellent’; and approximately 85% rated the physical environment item as ‘good’ to ‘excellent’ representation.

Qualitative Results.

Qualitative comments provided by reviewers on the ICRF were assessed for common themes and summarized. Overall, the items were positively received.

Phase Three - Test-retest

Measures

An instrument was designed with the PWES items in the same format as utilized in Aim Two (see Table 1).

Sample and Procedure.

For the test-retest assessment, a sample of 23 adult employees was drawn from two workplaces in Alberta. The majority of participants (*n* = 17) were obtained from a department in a large government organization, with the remaining 6 participants from various departments at a major Canadian University. The sample consisted of 11 men and 11 women with one participant not indicating his or her sex.

Streiner and Norman (1995) recommend a standard re-test interval of 2 to 14 days. A 14-day interval was chosen to minimize the recall of individual's previous scores. The sample of 23 employees completed both the PWES and the workplace physical activity measure. Participants from the department within the large government office (*n* = 17) were recruited through a contact at the workplace who informed employees of the study and provided instructions on how to participate. Interested employees were instructed to pick up and return study packages including an information letter, consent form, and the instrument in a labelled box in a specific location of the workplace on two occasions. University participants (*n* = 6) were recruited in an attempt to increase the sample size. E-mail addresses of University employees were obtained through networks and public domain information. Individuals were e-mailed the questionnaire and returned completed forms electronically. Data were analysed using SPSS 10 statistical software.

Analysis and Results

Internal Consistency of the PWES as a global construct.

Cronbach's alpha was calculated to test the internal consistency of the 6-item composite scale at time one and time two of the test-retest. The results revealed a standardized alpha of .81 and .85 at time one and time two respectively, providing evidence (Steiner & Norman, 1995) the six items could be utilized as a global construct as employed in Aim two.

Intraclass Correlation.

Streiner and Norman (1995) recommend the intraclass correlation coefficient as a robust assessment for determining test-retest reliability and thus was the analysis utilized to assess the PWES between time one and time two. The intraclass correlation coefficient for the PWES of .97 indicated the PWES was stable between the 14-day re-test interval.

Paired Sample T-test.

As a further assessment of test-retest reliability, a paired sample t-test was conducted between means for time one and time two for the PWES. The results of the assessment indicated there was no significant difference between means (e.g., $M = 2.34$, $SD = .82$; $M = 2.43$, $SD = .81$; $p = .12$) for time one and time two respectively.

Aim Two: Mediation Assessment

Recruitment and Sample.

This study was conducted as part of a randomized controlled trial (RCT) of a workplace physical activity intervention (Plotnikoff, Courneya, Spence, Birkett, & Marcus, 2003). This study utilized data from the baseline segment of the RCT rather than subsequent assessments to eliminate the chance of effects from the workplace physical activity intervention. To recruit the sample, the study was advertised by email and posters in three large Alberta organizations for two weeks prior to the actual distribution of questionnaires.

Every employee was sent a research package (containing the information letter, consent form, and questionnaire) within the internal mail system of his or her workplace. A total of 8000 questionnaires were sent, with 897 (11.2%) returned and sufficiently completed for analysis. The total sample was comprised of the following sub-samples: (1) a regional health authority (*n* = 409); (2) a post secondary educational institution (*n* = 170); and (3) city workers from a large Alberta city (*n* = 318).

The total sample's mean age was 42.2 years (*SD* = 9.91) and comprised a greater number of women than men (661 [74%] women, and 232 [26%] men, with 4 individuals not indicating sex). The sample represented a diverse worker population with 73% of participants being full-time employees, 25% were part-time workers, 5 participants were volunteer workers, and 9 did not indicate employment type. The sample was comprised of 25% shift workers.

Measures

In addition to the PWES the following measures were employed.

Self-Efficacy.

A validated nine-item self-efficacy scale assessed one's confidence for doing physical activity in different situations (e.g., when tired, when it becomes boring, etc.) on a 5-point Likert-type scale ranging from 'not at all confident' (1) to 'extremely confident' (5). The self-efficacy construct was calculated by adding the scores for each item, and then dividing by nine. The validity and reliability of these measures are reported in Plotnikoff, Blanchard, Hotz & Rhodes (2001) and Plotnikoff (2002).

Outcome Expectations.

A general measure of outcome expectations was obtained by asking individuals how much various statements about outcomes to physical activity behaviour would influence their decision to do regular physical activity. Responses were measured on a 5-point Likert-type scale from (1) "not at all" to (5) "very much". Both negative and positive assessments were obtained and calculated separately as outcome expectations (pros = 5 items), and outcome expectation (cons = 6 items; e.g. *outcome expectation pro*: Physical activity would help me reduce tension or manage stress; *outcome expectation con*: Physical activity would take too much of my time). The constructs were calculated by adding up the scores for all responses on the scale for pros and cons separately, and then dividing by the total number of questions for each. The validity and reliability of these measures are reported in Plotnikoff et al. (2001) and Plotnikoff (2002).

Workplace physical activity measure.

Physical activity incorporated into the workday was assessed with one question in order to reduce response burden. The question asked participants the degree to which they try to incorporate physical activity into their workday. The question was as follows: How much do you incorporate physical activity into your workday (e.g. during breaks, active commuting to and from work)? Participants responded on a 5-point option scale ranging from "none" (1) to "a great deal" (5). This workplace physical activity measure was assessed for test-retest reliability with same method as described in the Aim one methods section revealing an intraclass correlation coefficient of .86 and similar means determined in the paired sample t-test (e.g., $M = 2.96$, $SD = .98$; $M = 2.96$, $SD = .93$; $p = 1.00$).

Leisure-Time Physical Activity.

Leisure-time physical activity was measured using a modified Godin Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985). This instrument asked participants how many times per week they engage in strenuous, moderate, and mild physical activity. The definitions for these three levels of intensity were defined in the following way: (1) Strenuous physical activity: (heart beats rapidly, sweating) Examples included: running, jogging, hockey, soccer, cross country skiing, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance, heavy weight training; (2) Moderate physical activity: (not exhausting, light perspiration) Examples included: fast walking, baseball, tennis, easy bicycling, swimming, volleyball, popular and folk dancing; (3) Mild physical activity: (minimal effort, no perspiration) Examples: easy walking, yoga, archery, bowling, golf.

Study participants were instructed to only include activities with a duration of 10 minutes or more. This differs from the original Godin instrument that utilized a 15 minutes or more requirement. The 10 minutes or more criterion was utilized to coincide with physical activity recommendations of Canada's Physical Activity Guide (Health Canada, 2000). The Godin instrument specifies the metabolic equivalent (times the resting metabolic level) (MET) values for strenuous physical activity as 9 METS; moderate physical activity as 5 METS; and mild physical activity as 3 METS (Godin & Shepard, 1985). The total leisure activity score was calculated using the following formula: $\text{LPA} = (\text{N} \cdot \text{MET})_{\text{light}} + (\text{N} \cdot \text{MET})_{\text{moderate}} + (\text{N} \cdot \text{MET})_{\text{hard}}$

Where: LPA = Total leisure physical activity score
N = number of physical activity bouts per week lasting 10 minutes or longer

Analysis / Results

The data were screened using methods described by Tabachnick & Fidell, (1989). Cronbach's alpha was determined for all composite scales to test for internal consistency. The PWES had an alpha coefficient of .83, the self-efficacy scale was .92, outcome expectation (pros) was .81, and outcome expectation (cons) was .74 which were all acceptable (Streiner and Norman, 1995).

As this study was exploratory, bivariate correlation analyses were completed between each PWES item and the global PWES construct, the cognitive constructs, and physical activity. All PWES items were moderately to highly correlated [range = .30 to .63 (*p* =.01)] adding further justification for their employment as a global PWES construct. Leisure-time physical activity was only marginally correlated with each PWES item [range = .07 to .13] and the PWES construct [.13 (*p* =.01)], and was moderately correlated to the cognitive constructs of self efficacy [.47 (p =.01)], outcome expectations pros [.20 (p =.01)], outcome expectations cons [.-.25 (p =.01)], and workplace physical activity [.39 (p=.01)]. The workplace physical activity measure was slightly correlated to each PWES item [range = .14 to .19 (p =.01)] and the global PWES construct [.23 (p =.01)] and self-efficacy [.37 (p =.01)], and slightly correlated to outcome expectation pros [.17 (p =.01)], and outcome expectation cons [-.18 (p =.01)]. See Table 3 for the correlation matrix.

INSERT TABLE 3. ABOUT HERE

Since the sample was derived from three different organizations (i.e., (1) health authority, (2) educational institution, (3) city workers) one-way ANOVAs were conducted to assess sub-sample compatibility across the different constructs. The ANOVAs revealed significant F values for all measures except self-efficacy and outcome expectations pros. The Scheffe post-hoc test was administered to further assess potential significant differences between means revealing the educational institution differed from the other two sub-samples (i.e., health authority and city workers) for outcome expectation cons, leisure-time physical activity, and workplace physical activity. Further, all three sub-samples differed on the PWES.

Therefore, to test the effect of site on the relationships between the criterion and predictor variables, two dummy variables were created for site with values 1 and 0. This was done by creating two new variables for site and assigning them values of zero, then using the "IF" function in SPSS 10, to replace the zeros with ones for the appropriate conditions (e.g. if site = 1 then health authority = 1; if site = 2 then city = 1; if site = 3 then educational institution = 1). Only two indicator variables were included in each equation, as the third does not add further explanation to the model as each dummy variable are mathematical functions of each other (Allen, 1997). This procedure controlled for possible site effects on the four-step mediation analyses described below.

Step One: Self-efficacy and outcome expectations regressed on the PWES.

According to Baron and Kenny (1986), to move on to the next step of the mediation analysis, the predictor variable (PWES) must be significantly associated with the potential mediators (i.e., self-efficacy and outcome expectations). Self-efficacy and outcome expectations were regressed on the PWES. The dummy variables for site were included in hierarchical regressions as block one, with the PWES being included as block two.

The entire model explained 4% of the variance in self-efficacy. Site explained 0% of the variance, with the PWES explaining the entire 4% ($\beta = 0.2$ [$p =. 01$]). The entire model explained only 1% of the variance in outcome expectation pros. Site had no association to outcome expectation (pros) ($R^2 adj = .00$), with the PWES explaining 1% ($\beta = 0.1$ [$p =. 01$]). The entire model explained 3% of the variance in outcome expectation cons. Site explained 2% of the variance, with the PWES adding an additional 1% ($R^2 adj = .03$) ($\beta = -.12$ [$p =. 01$]). (See Table 4 for a summary of results).

INSERT TABLE 4. ABOUT HERE

Site had a minimal effect on the relationships observed in the full sample for self-efficacy and outcome expectation pros, but did have an effect on the already small relationship between the PWES and outcome expectations cons. In the mediation analysis, it is assumed the predictor variable causes the mediator (Baron & Kenny, 1986). The associations between the PWES and the cognitive constructs were marginal. Self-efficacy had the strongest association without site effects; therefore it was decided to continue on to the next step (see Step Three) of the mediation analysis with self-efficacy as the only potential mediator.

Step Two: Physical activity behaviour regressed on the PWES.

To continue on to Step Three of the mediation analysis, the PWES must be associated significantly with physical activity behaviour (Baron & Kenny, 1986). The dummy variables for site were included into hierarchical regression models as block one, and the PWES as block two.

The full model accounted for 2% of the variance in leisure-time physical activity. Site explained 1% of the variance, with the PWES explaining a further 1% (β =. 09 [*p* =. 01]). The entire model explained 5% of the variance in workplace physical activity. Site explained 1% of the variance, with the PWES adding a further 4% (β =. 23 [*p* =. 01]). (See Table 5 for results of these equations).

Since the degree of the relationship between the PWES and leisure-time physical activity was negligible ($R^2adj = .01$) there would be a minimal relationship to potentially mediate. It was decided, therefore, to no longer include leisure-time physical activity in subsequent steps of the mediation analyses. The mediation analyses continued on to Step Three with workplace related physical activity as the only criterion variable.

Step Three: Workplace physical activity regressed on self-efficacy.

In order to act as a mediator, self-efficacy must be a significant predictor of workplace physical activity. The next regressions were completed with self-efficacy as the predictor variable and workplace physical activity as the criterion. The site dummy variables were included in hierarchical regression as block one and self-efficacy as block two.

The full model explained 14% of the variance in workplace related physical activity. Site explained 1% of the variance, with self-efficacy explaining the additional 13% ($\beta = .36$ [$p = .01$]). Table 5 provides a summary of results. Site played a minimal role in the relationship between self-efficacy and workplace related physical activity.

Step Four: Test for mediation of self-efficacy on the relationship between the PWES and workplace physical activity behaviour.

In this final step, workplace physical activity was regressed on self-efficacy and the PWES. The mediator (self-efficacy) must be significantly associated with workplace physical activity in this equation (Baron & Kenny, 1986). In order to show mediation, the relationship between the PWES and workplace physical activity behaviour must be less in this equation then in Step Two, and will show perfect mediation if the PWES has no effect on physical activity behaviour when self-efficacy is controlled (Baron & Kenny). Site was not included in this regression as it was determined by previous steps to have minimal influence on the relationships observed between the criterion and predictor variables in this equation. Self-efficacy was entered into the hierarchical equation as block one, with the PWES being entered as block two.

The entire model explained 16% of the variance in workplace-related physical activity. Self-efficacy explained 13% of the variance, with the PWES explaining a further 3%. Table 5 shows results of this equation. Results indicate there was slight mediation by self-efficacy on the relationship between the PWES and workplace-related physical activity, as there was a reduction in the beta value of this relationship from $\beta = .23$ to $\beta = .16$. Further, the variance in workplace physical activity explained by the PWES declined from 4% in step two of the mediation analysis, to 2% in this final regression when accounting for the 1% variance predicted by site determined in Step Two.

INSERT TABLE 5. ABOUT HERE

Discussion

The first aim of this study was to develop and assess psychometric properties of a global scale to assess the perceived workplace environment on multiple levels. The initial scale development utilized previous work of Plotnikoff et al. (2003) to identify relevant content definitions for six levels of a workplace physical activity audit (WPAAT), and create one question for each level to limit response burden. A brief scale was required as this study was incorporated into the baseline questionnaire of another longitudinal intervention study (Plotnikoff, et al. 2003). The psychometric properties of the resulting six Likert-type items (i.e., PWES) were assessed for content validity, internal consistency, and test-retest reliability.

Results of the expert review provided content validity evidence as the expert panel indicated each item of the PWES represented the content descriptions of the six environment levels in the WPAAT to a high degree. In addition, there was consensus between the three groups of experts (i.e., researchers, practitioners, and employees) determined by ANOVA analyses. Qualitative data provided further confirmation regarding the validity of the scale in addition to suggestions for consideration in subsequent utilization of the PWES.

The PWES was shown to have adequate internal consistency over three different assessments. Cronbach's alpha coefficients of .81 at time one, and .85 at time two of the test-retest reliability assessment in the sample of 23 employees, and an alpha coefficient of .83 in the large sample of 897 employees in the mediation analyses were all acceptable (Bernard, 2000; Streiner & Norman, 1995). Further, test-retest analyses revealed the PWES was stable over a two week time period as determined by the paired sample t-test and intraclass correlation analysis (ICC = .97). The workplace physical activity measure utilized in Aim Two also displayed strong test re-test reliability (ICC = .86).

The PWES items were utilized as a global ecological construct in the mediation analyses as there was reasonable support from the data to do so. All of the PWES items were moderately to highly correlated, and the scale had adequate internal consistency suggesting each of the items were assessing one underlying construct. This could be due to the global nature of the PWES items, and the fact that the levels of the workplace physical activity model overlap (Plotnikoff et al. 2003), but also suggests perceptions of the different levels of the workplace environment are related. This finding is similar to those reported by Duncan and others (2002), who reported significant associations between perceived neighbourhood environment items.

In a recent review of 19 studies conducted by Humpel, Owen and Leslie (2002) assessing the relationships between perceived and objective physical environments and physical activity, found environment items pooled into composite variables were less likely to be statistically significant. Utilizing the PWES construct however, was preferable for the mediation analyses, as it minimized the amount of regressions to be completed reducing the possibility for relationships to be found by chance (Norman & Streiner, 1999). For example, if the global construct had not been created, regressions would have to be conducted for each of the six PWES items separately creating 24 possible regression equations for each potential mediator in the protocol described by Baron and Kenny (1986), as apposed to four when utilizing the PWES as a global construct.

The development of the PWES addresses a need identified in the literature for scales assessing multiple levels of various environments in the context of physical activity (Sallis & Owen, 2002). Due to the costly and time-consuming nature of obtaining objective environment assessments, the development of such perceived environment measures is a valuable contribution to this area of study (Sallis, Johnson, Calfas & Caprosa, 1997). Previous research has shown a high correlation between the perceived and objective physical environment in the context of physical activity in high school students (Fein, Plotnikoff, Spence & Wild, 2003). This brief and easy to administer scale demonstrated minimal missing cases, along with a normal data distribution. The PWES has utility for workplace physical activity research projects utilizing large samples by providing an economical way to include a multi-level perceived environment assessment. Further, the scale could be modified to address the perceived workplace environment in the context of other health related behaviours such as smoking or diet.

Aim Two of this study was to determine if the PWES was related to physical activity behaviour of workplace employees and further, to employ a mediation protocol described by Baron and Kenny (1986) to assess if the relationship between the PWES and physical activity behaviour was mediated by self-efficacy and outcome expectations. In the initial data screening, ANOVA analyses determined the three sub-samples comprising the large mediation sample (i.e., regional health authority, educational institution, and city workers) differed on the PWES, physical activity, and outcome expectation cons variables. To continue utilizing the three sub-samples as one sample for parsimonious analyses and reporting, dummy variables were created to control for site effects in the four step regression protocol (Baron & Kenny). Subsequently, minimal site effects were observed in the four step mediation analyses eliminating the need to report results for each sub-site separately.

An assumption of the mediating relationship is the predictor variable causes the mediator, and thus they should be related (Baron & Kenny, 1986). The PWES only explained 1% of the variance in both outcome expectation pros and cons making them unlikely mediators. The PWES explained 4% of the variance in self-efficacy and was utilized in subsequent steps of the analysis. Self-efficacy has received more support as a mediator then outcome expectations in the limited physical activity research assessing mediators (Lewis et al. 2002). Further, self-efficacy has been shown to be a stronger correlate of physical activity in workplace samples (Stutts, 2002). These findings suggest employees' perceptions of their workplace environment may influence their belief they can engage in physical activity under different circumstances (e.g., when they have many other demands on their time), and is not associated to their outcome beliefs about physical activity (e.g., physical activity would help me control my weight).

The PWES was not related to leisure-time physical activity of employees ($R^2adj.$ = 0.1), and slightly associated with physical activity employees incorporate into their workday ($R^2adj.$ = 0.4). Even though both dependent measures had significant Beta coefficients, the degree of the relationships were small and were likely significant (especially leisure-time physical activity) due to the large sample size resulting in high power (Tabachnick & Fidell, 1989). Large correlations between the environment and physical activity are not expected due to many other factors influencing physical activity (i.e., biological factors; Sallis et al. 1997) and this minimal relationship is similar to findings in two previous studies assessing the relationship between physical activity and the perceived environment in school and neighbourhood settings (Fein, Plotnikoff, Wild & Spence, in press; Sallis et al.).

Aside from potential measurement error and other influences of physical activity, the small relationships observed between the PWES and physical activity could be due to an unsupportive workplace environment of physical activity. This non-intervention assessment was conducted assessing current conditions of the workplace. If the workplace was a neutral environment, it is logical to assume it could have little association with physical activity behaviour, and other settings could be having a stronger influence (i.e., home environment, neighbourhood environment). It can be interpreted that employee perceptions of the workplace environment may be a stronger correlate of physical activity employees try to incorporate into their workday of an active living type (i.e., taking the stairs instead of the elevator, taking active breaks instead of coffee breaks). It is also possible employees who try to include physical activity into their workday perceive their workplace environment as more supportive of physical activity. As this was a cross-sectional study design, the direction of causality however cannot be determined.

Self-efficacy was found to marginally mediate the relationship between the PWES and workplace physical activity. In this case, self-efficacy cognitions explained more then twice the variance in workplace physical activity than the PWES. This result provides support for the necessary inclusion of cognitions in understanding physical activity behaviour, and the environment should not be examined in isolation when assessing environmental associations with physical activity. These findings also suggest the perceived workplace environment may influence employee's self-efficacy to engage in physical activity at work, thereby influencing the physical activity individuals incorporate into their workday.

This study adds support to the interplay between the environment, cognitions, and behaviour as described by reciprocal determinism in SCT (Bandura, 1986), and further supports the strong cognitive component in the occurrence of physical activity behaviour suggested by Maddux (1997). The findings do not disprove the environment can directly influence physical activity as the environment assessment was perceived rather than objective. This study however, does provide further empirical evidence to support the hypothesis suggested by Spence and Lee (2003) that psychological constructs mediate the relationship between environmental factors and physical activity behaviour.

This study found outcome expectations did not act as a mediator. This finding is similar to conclusions drawn from a review conducted by Lewis and colleagues (2002) of physical activity research assessing mediators. Lewis and colleagues concluded self-efficacy was supported as a mediator, whereas outcome expectations had inconclusive findings. Since outcome expectations were not associated to the PWES, it could also be possible psychological mediators may differ across settings.

As this study was somewhat exploratory (i.e., utilizing new measures of the perceived environment in a novel manner), the study findings must be interpreted with caution. As in most behaviour research, an assumption is the behaviour in question, potential mediating variables, and predictor variables can be adequately evaluated (Baranowski, Lin, Wetter, Reniscow & Hearn, 1997). There was only one item representing each of the environment levels of the workplace resulting in a broad assessment of the environment, which may have limitations on the findings. There has been support for employing perceived environment measures (Fein et al. 2003; Sallis et al. 1997), however, objective measures would strengthen the assessment of the environment and behaviour relationship and is recommended for future assessments. Additionally, the cognitive measures employed in this study were general measures of physical activity self-efficacy and outcome expectations. Having cognitive measures specific to the workplace setting would have strengthened the study, and is recommended for future studies. Further, the small relationships observed with such a high degree of power due to the large sample size indicate overall effects of this study were minimal.

A strength of this study is the setting was well defined making the environment levels easy for participants to interpret. The workplace is a specific environment making it ideal for testing ecological variables and relationships with physical activity behaviour and cognitive constructs. It may be much easier to assess the social environment of the workplace for example, than that of an entire community. Since this study was relatively exploratory in nature, it would be valuable to conduct similar studies to determine the reproducibility of the results.

As recommended by other researchers in the physical activity domain (e.g., Baranowski et al. 1998; Bauman et al. 2002; Lewis et al. 2002; Sallis & Owen, 2002; Spence & Lee, 2003), more studies examining mediators should continue to be conducted. Such research could greatly increase the understanding of how interventions influence physical activity behaviour, and could aid in the development of ecological interventions focussed on levels of the environment, rather than psychological characteristics. Longitudinal study designs assessing interventions' influences on potential mediators like self-efficacy over time could provide a way to evaluate the efficacy of the intervention, and would help establish a needed understanding of causal relationships.

References

Allen, M. P. (1997). *Understanding Regression Analysis.* New York: Plenum Press.

Autonomous Government of Catalonia (1996). The Catalonia declaration: Investing in heart health. Barcelona, Catalonia: The Author

Bandura, A. (1986). *Social Foundations of Thought and Action*, New Jersey: Prentice-Hall, Inc.

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *American Journal of Preventive Medicine, 15,* 266-297.

Baranowski, T., Lin, L., Wetter, D. W., Resnicow, K., & Davis Hearn, M. (1997). Theory as mediating variables: Why aren't community interventions working as desired? *Annals of Epidemiology, 7,* S89-S95.

Baranowski, T., Perry, C. L., & Parcel, G. S. (1997). How individuals, environments, and health behavior interact. In Glanz, K., Lewis, F. M., Rimer, B. K. (Eds.), *Health Behaviour and Health Education Theory, Research, and Practice. (2nd Ed.* pp. 153-178). San Francisco, California: Jossey – Bass.

Bargh, J. A., & Gollwitzer, P. M. (1994). Environmental control of goal-directed action: automatic and strategic contingencies between situations and behavior. *Nebraska Symposium on Motivation, 41,* 71-124.

Baron, R. M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bauman, A., Pratt, M., Sallis, J., F. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine 15*, 379-395.

Bauman, A., Sallis, J. F., Dzewaltowski, D. A. & Owen, N. (2002). Toward a better understanding of the influences of physical activity. The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine, 23,* 5-14.

Crump, C. E., Earp, J. A. L., Kozma, C. M., & Hertz Picciotto, I. (1996). Effect of organization-level variables on differential employee participation in 10 federal worksite health promotion programs. *Health Education Quarterly 23*, 204-223.

Culos-Reed. C., Gyurcsik, N. C., Brawley, L. R. (2001). Using theories of motivated behaviour to understand physical activity. (Chapter 27). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M (Eds.) *Handbook of Sport Psychology* (pp. 695-717). New York: John Wiley & Sons, Inc.

Dishman, R. K., Oldenburg, B., O'Neal, H., & Shepard, R. J. (1998). Worksite physical activity interventions. *American Journal of Preventive Medicine, 15* (4). 344-359.

Duncan, S. C., Duncan, T. E., Stryker, L. A., & Chaumeton, N. R. (2002). Neighborhood physical activity opportunity: a multi-level contextual model. *Research Quarterly for Exercise and Sport, 73,* 457-463.

Dunn, J.G., Bouffard, M., & Rogers, W. T. (1999). Assessing item content-relevance in sport psychology scale-construction research: Issues and recommendations. *Measurement in Physical Education and Exercise Science, 3,* 15-36.

Dzewaltowski, D. A. (1994). Physical activity determinants: A social cognitive approach. *Medicine and Science in Sports and Exercise. 26,* 1395-1399.

Heirich, M. A., Foote, A., Erfurt, J. C., & Konopka, B. (1993). Work-site physical fitness programs: Comparing the impact of different program designs on cardiovascular risks. *Journal of Occupational Medicine, 35*, 510-527.

Fein, A. J., Plotnikoff, R. C., Wild, T. C., & Spence, J. C. (in press). Perceived environmental context and the physical activity in youth. *International Journal of Behavioural Medicine.*

Fein, A. J., Plotnikoff, R. C., Wild, T. C., & Spence, J. C. (2003). An examination of adolescents' perceptions of the school environment related to physical activity. Submitted for publication.

Gauvin, L., Levesque, L., & Richard, L. (2001). Helping people initiate and maintain a more active lifestyle. A public health framework for physical activity promotion research. (Chapter 28). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M (Eds.) *Handbook of Sport Psychology* (pp. 718-739). New York: John Wiley & Sons, Inc.

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54,* 1793-1812.

Godin, G., & Shepard, R. J. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Science, 10,* 141-146.

Green, L.W., Potvin, L., & Richard, L. (1996). Ecological foundations of health promotion. *American Journal of Health Promotion, 10*, 270-281

Hallam, J., & Petosa, R. (1998). A worksite intervention to enhance social cognitive theory constructs to promote exercise adherence. *American Journal of Health Promotion, 13*, 4-7.

Hansen, W. B., & McNeal, R. B. (1996). The law of maximum expected potential effect: constraints placed on program effectiveness by mediator relationships. *Health Education Research, 11,* 501-507.

Health Canada. (2001). *Health Canada's business case for active living at work. Trends and impact - the basis for investment decisions.* Retrieved August, 25, 2003, from http://www.hc-sc.gc.ca/hppb/fitness/work/trends_e.html

Heaney, C.A., & Goldenhar, L.M. (1996). Worksite health programs: Working together to advance employee health. *Health Education Quarterly, 23*, 133-136.

Hollander, R. B., & Lengermann, J. J. (1988). Corporate characteristics and worksite health promotion programs: Survey findings from the Fortune 500 companies. *Social Science and Medicine, 26,* 491-501.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity: a review. *American Journal of Preventive Medicine, 22,* 188-199.

Iso-Ahola, S. E., & St. Clair, B. (2000). Toward a theory of exercise motivation. *QUEST,* 52. 131-147.

Lewis, B. A., Marcus, B. H., Pate, R. R. & Dunn, A. L. (2002). Psychosocial mediators of physical activity beahvior among adults and children. *American Journal of Preventive Medicine, 23,* 26-35.

Maddux, J. E. (1997). Habit, health, and happiness. *Journal of Sport & Exercise Psychology, 19,* 331-346.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15,* 351-377.

Norman, G. R., & Streiner, D. L. (1999). *PDQ Statistics* (2nd ed.). Hamilton: B.C Decker Inc.

Plotnikoff, R. C. (2002). The development of social-cognitive measures in the exercise domain: Issues and challenges. *Measurement in Physical Education and Exercise Science, 6* , 255-261.

Plotnikoff, R. C., Courneya, K., Spence, J., Birkett, N., & Marcus, B. (2003). [A randomized control trial of physical activity interventions in Alberta]. Unpublished raw data.

Plotnikoff, R.C., Fein, A. J., Prodaniuk, T. R., & Milton, L. (2003). Development of the workplace physical activity audit tool. Submitted for publication.

Plotnikoff, R. C., Hotz, S. B., Birkett, N. J., & Courneya, K. S. (2001). Exercise and the transtheoretical model: A longitudinal test of a population sample. *Preventive Medicine, 33.* 441-452.

Polanyi, M. F. D., Frank, J. W., Shannon, H. S., Sullivan, T. J., & Lavis, J., N. (2000). Promoting the determinants of good health in the workplace. Poland, B. D., Green, L. W., & Rootman, I. (Eds.) Settings For Health Promotion Linking Theory and Practice. Sage Publications, 139-160.

Richard, L., Potvin, L., Kishchuk, N., Prlic, H. & Green, L. W. (1996). Assessment of the integration of the ecological approach in health promotion programs. *American Journal of Health Promotion, 10,* 318-328.

Sallis, J. F., Johnson, M. F., Calfas, K. J., Caparosa, S., & Nichols, J. F. (1997). Assessing perceived physical environmental variables that may influence physical activity. *Research Quarterly for Exercise and Sport, 68,* 345-351.

Sallis, J.F. & Owen, N., (1997). Ecological Models. In Glanz, K., Marcus Lewis, F., Rimer, B. K. (Eds.).*Health Behaviour and Health Education* (pp. 403-424). (2nd Ed.) San Francisco, California: Jossey – Bass.

Sallis, J. F., & Owen, N. (2002). In Glanz, K., Marcus Lewis, F., Rimer, B. K. (Eds.).*Health Behaviour and Health Education.* (3rd Ed.).

Shepard, R. J. (1996). Worksite fitness and exercise programs: a review of methodology and health impact. *American Journal of Health Promotion, 10*, 436-451.

Shepard, R. J. (1992). A critical analysis of worksite fitness programs and their postulated economic benefits. *Medicine and Science in Sports and Exercise, 24,* 354-370.

Sloan, R. P. (1987). Workplace health promotion: A commentary on the evolution of a paradigm. *Health Education Quarterly, 14,* 181-194.

Spence, J., Lee, R., (2003). Toward a comprehensive model of physical activity. *Psychology of Sport and Exercise, 4,* 7-24.

Stokols, D., Pelletier, K. R. & Fielding, J. E. (1996). The ecology of work and health: research and policy directions for the promotion of employee health. *Health Education Quarterly, 23*, 137-158.

Streiner, D. L., & Norman, G. R. (1995). *Health measurement scales. A practical guide to their development and use* (2nd ed.). New York: Oxford University Press.

Stutts, W. C. (2002). Physical activity determinants in adults. Perceived benefits, barriers, and self-efficacy. *AAOHN Journal, 50,* 499-507.

Tabachnick, B.G., & Fidell, L.S. (1989). *Using multivariate statistics*. (2nd ed.). New York: Harper & Row Publishers.

US Department of Health and Human Services. (1996), Physical activity and health: A report of the surgeon general. Atlanta, GA: The Author.

Wanzel, R.S. (1994). Decades of worksite fitness programmes. Progress or rhetoric? *Sports Medicine, 158,* 224-230.

TABLE 1. Items of the Perceived Workplace Environment Scale (PWES)

Item in the PWES	Question
Individual level item	How much information is provided in your workplace educating and/or encouraging employees about physical activity?
Social level item	Is there a positive social climate that encourages physical activity in your workplace?
Community level item	Has your organization used any services or resources in the community to support the physical activity of employees? (examples: local recreation centre, community events)
Organizational level item	How much organizational capacity (i.e. infrastructure, will, and leadership) is there in your workplace that promotes physical activity for employees?
Policy level item	Does your workplace have policies that promote the physical activity of employees? (examples: no meetings scheduled over lunch, subsidized memberships at a fitness centre)
physical environment level item	Are there convenient and appropriate facilities that you can access in order to do physical activity during the workday?

Note: Employees indicated their answers by circling the phrase and number they most agreed with on a 5-point response option scale (1= none; 5 =a great amount). These six items were used as a composite scale by adding the scores for each item and dividing by six.

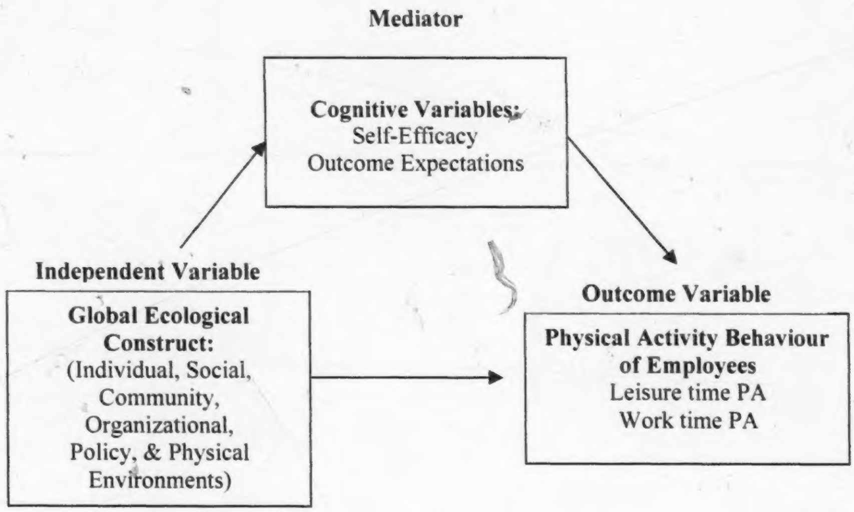
Mediator
Cognitive Variables:
Self-Efficacy
Outcome Expectations
Independent Variable
Global Ecological Construct:
(Individual, Social, Community, Organizational, Policy, & Physical Environments)
Outcome Variable
Physical Activity Behaviour of Employees
Leisure time PA
Work time PA

Figure 1. (adapted from Baron & Kenny, 1986)

TABLE 2. Expert Review Means, Standard Deviations, and ANOVA Results

Variable[*]	Workers (n=5) Mean (SD)	Practitioners (n=5) Mean (SD)	Researchers (n=5) Mean (SD)	F	p
individual	3.6 (.9)	2.4 (1.7)	3.4 (1.5)	1.05	.38
Social	4.0 (1.0)	3.8 (.8)	3.4 (1.1)	.47	.64
Organization	4.4 (.6)	3.4 (1.1)	3.2 (1.1)	2.21	.15
Community	5.0 (.0)	4.6 (.9)	4.0 (.7)	2.92	.09
Policy	5.0 (.0)	4.6 (.9)	4.2 (.5)	2.40	.13
Physical environment	4.2 (.8)	4.2 (1.3)	3.6 (1.1)	.49	.63

[*]Note: variables were evaluated on a 5-point Likert type scale ranging from (1 = poor representation) to (5 = excellent representation)

TABLE 3. Pearson Correlations between the PWES items and construct, physical activity measures, and cognitive constructs.

	LPA	WPA	SE	PRO	CON	*IND*	*SOC*	*COM*	*ORG*	*POL*	*PHY*	PWES
LPA	1.00	$.39^{**}$	$.47^{**}$	$.20^{**}$	$-.25^{**}$	$.07^{*}$	$.12^{**}$	$.08^{*}$	$.11^{**}$	$.09^{**}$	$.08^{*}$	$.13^{**}$
WPA		1.00	$.37^{**}$	$.17^{**}$	$-.18^{**}$	$.19^{**}$	$.17^{**}$	$.14^{**}$	$.19^{**}$	$.17^{**}$	$.16^{**}$	$.23^{**}$
SE			1.00	$.31^{**}$	$-.44^{**}$	$.15^{**}$	$.18^{**}$	$.10^{**}$	$.16^{**}$	$.14^{**}$	$.18^{**}$	$.20^{**}$
PRO				1.00	$-.13^{**}$	.05	.06	.03	.05	.04	$.13^{**}$	$.08^{*}$
CON					1.00	$-.18^{**}$	$-.09^{**}$	$-.14^{**}$	$-.10^{**}$	$-.07^{*}$	$-.14^{**}$	$-.15^{**}$
IND						1.00	***.57*****	***.46*****	***.62*****	***.41*****	***.33*****	***.75*****
SOC							1.00	***.47*****	***.63*****	***.41*****	***.38*****	***.77*****
COM								1.00	***.54*****	***.56*****	***.27*****	***.74*****
ORG									1.00	***.46*****	***.46*****	***.83*****
POL										1.00	***.30*****	***.72*****
PHY											1.00	***.64*****
PWES												1.00

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Note: PWE variables comprising the PWES are presented in bold italics

LPA= Leisure Time Physical Activity
WPA= Workplace Physical Activity
SE= Self-Efficacy
PRO= Outcome Expectations Pros
CON= Outcome Expectations Cons
IND= Individual Level Item
SOC= Social Level Item
COM= Community Level Item
ORG= Organization Level Item
POL= Policy Level Item
PHY= Physical Environment Item
PWES= Global Ecological Construct

TABLE 4. Hierarchical Regression: Mediators regressed on the PWES and Site Dummy Variables

Step One: Site and the PWES as Predictors

Self-efficacy (n=836)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.00	.01	2.62		
Site one				.06	
Site two				.08	
Block 2	.04	.04	30.81*		
PWES construct					.20*
Outcome Exp. Pros (n=844)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.00	.00	1.00		
Site one				-.05	
Site two				-.01	
Block 2	.01	.01	8.04*		
PWES construct					.10*
Outcome Exp. Cons (n=840)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.02	.02	7.59*		
Site one				-.05	
Site two				-.14*	
Block 2	.03	.01	12.22*		
PWES construct					-.12*

$^*p < .01$

Note: Beta 1 and Beta 2 are the standardised regression coefficients for the linear equations represented by blocks one and two.

TABLE 5. Hierarchical Regressions for Steps Two, Three, and Four

Step Two: Site and PWES as Predictors

Leisure Time PA (n=820)	R^{2}adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.01	.02	6.37*		
Site one				.11*	
Site two				.11*	
Block 2	.02	.01	6.45		
PWES construct					.09*

Work Time PA (n=846)	R^{2}adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.01	.01	3.33		
Site one				.09	
Site two				.07	
Block 2	.05	.05	42.53*		
PWES construct					.23*

Step Three: Site and Self-efficacy as Predictors

Work Time PA (n=860)	R^{2}adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.01	.01	3.11		
Site one				.08	
Site two				.06	
Block 2	.14	.13	129.39*		
Self-efficacy					.36*

Step Four: Self-efficacy and PWES as Predictors

Work Time PA (n=836)	R^{2}adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.13	.13	128.32*		
Self-efficacy				.37*	
Block 2	.16	.02	23.27*		
PWES Construct			*Previous $\beta = .23^*$*		.16*

$^*p < .01$

Note: Beta 1 and Beta 2 are the standardised regression coefficients for the linear equations represented by blocks one and two.

CHAPTER IV – CONCLUSIONS

This chapter presents the main conclusions from the two study aims followed by the study limitations, future directions for research, and the implications of the findings for practice and policy.

Main Conclusions

Aim One of this project was to develop and assess psychometric properties of a global scale to assess the workplace environment on multiple levels. This was accomplished by utilizing an ecological model and audit tool for physical activity in the workplace (WPAAT) developed by Plotnikoff and colleagues (2003) to create the initial scale items. The resulting scale items were assessed for content validity, internal consistency, and test-retest reliability. The three phases of assessments indicated: (1) the scale items represented the matching environment level content definitions of the ecological workplace physical activity model (Plotnikoff et al.); (2) the measure showed strong internal consistency as a global ecological construct and (3) the scale was stable over a two week time period.

The development of the PWES represents an attempt to assess multiple levels of the workplace environment in a way that can be easily incorporated into survey studies with large samples. Due to the costly and time-consuming nature of obtaining objective environment assessments, the development of such perceived environment measures is a valuable contribution to this area of study (Sallis et al. 1997). Further, previous research has shown a high correlation between the perceived and objective physical environment (Fein, Plotnikoff, Spence & Wild, 2003). Objective environment measures of more abstract environment levels, such as the social environment, may be very challenging to establish. Further, it has been suggested perceptions individuals have of environments they interact with may be more powerful in shaping their cognitions and behaviour then the objective environment (Sallis et al. 1997). Thus, the development of the PWES provides one approach to assess perceptions of the multi-level workplace environment that could be built on in future studies.

Aim Two of this project was to determine if the PWES was associated with physical activity behaviour of employees and further, to assess if any existing relationship was mediated by self-efficacy and outcome expectations. A series of regression analyses were completed as described by Baron and Kenny (1986) to address the research questions of Aim Two.

Regression analyses determined the PWES predicted 4% of the variance in a workplace physical activity variable, and only 1% of the variance in leisure-time physical activity. Large correlations between the environment and physical activity are not necessarily expected due to many other factors influencing physical activity (i.e. biological factors) (Sallis et al. 1997). The marginal association of the PWES with leisure-time physical activity however, could be due to poor measurement of the perceived workplace environment and/or physical activity, or it could be an indication the perceived workplace environment does not influence leisure-time physical activity. Further, this minimal relationship may be because the workplaces in question do not actively promote leisure-time physical activity, and thus the perception of the environment has no explanation of power. The stronger, albeit relatively small association of the PWES with the workplace physical activity variable, suggests the perceived workplace environment is more related to physical activity that employees try to incorporate into their workday. Since the relationship between the PWES and leisure-time physical activity was marginal (even with high power of a large sample size) the mediation analysis proceeded with the workplace physical activity variable as the only dependent variable.

The mediation model assumes the predictor variable (PWES) effects the mediator (cognitive construct), so the PWES must be significantly related to self-efficacy and outcome expectations (Baron & Kenny, 1986). Regressions slightly supported the association of self-efficacy with the PWES ($R^2adj = .04$), but only marginal associations existed between outcome expectation pros and cons (i.e., the PWES predicted 1% of the variance in outcome expectation pros and cons). The stronger association between the PWES and self-efficacy can be logically interpreted. Bandura (1997) has described self-efficacy as the perceived ability to control one's actions in different situations. The perceptions of the workplace environment could influence the feeling of control employees have over whether they can do physical activity more then their beliefs about positive and negative outcomes of physical activity. Employees who perceive the workplace environment as supportive of their physical activity may feel as they have more control over whether they can do physical activity in different circumstances (i.e., when they have many demands on their time).

Self-efficacy predicted 13% of the variance in the workplace physical activity variable ($R^2adj = .13$). The final regression in the mediation analysis (controlled for self-efficacy) revealed the PWES declined from 4% to 2% in predicting the variance in the workplace physical activity variable. Further, the beta coefficient for the PWES declined from 0.23 to 0.16 in this equation indicating self-efficacy acted as a mediator of the relationship. These results suggest the perceived workplace environment may influence employee's self-efficacy to engage in physical activity, which then determines their physical activity behaviour. These findings add support to the hypothesis that strong cognitive predictors such as self-efficacy account for most of the relationship observed between the environment and physical activity behaviour (Spence & Lee, 2003) and that self-efficacy is one of the strongest cognitive correlates of physical activity (Maddux, 1997). The findings do not disprove that a direct relationship between the environment and physical activity exists, as the environment was measured as a perception, rather than an objective assessment. The findings do suggest self-efficacy is a stronger predictor of physical activity than the perceived environment and should be considered as a mediator in ecological models focussed on physical activity promotion. This finding is consistent with a recent review examining assessments of mediators in the physical activity domain that found support for self-efficacy as a mediator in the few studies conducted (Lewis, Marcus, Pate & Dunn, 2002).

Limitations

Notwithstanding several strengths of this study (e.g., large diverse worker sample, the validity and reliability characteristics determined for the PWES), there are a number of important limitations to be considered when interpreting the study findings. A possible limitation of the PWES is its lack of specificity due to its brevity. The global nature of the scale items makes their resulting data more subjective (i.e., overall perceptions of the workplace environment), rather than the objective characteristics of the workplace environment. Further, utilizing perceived environment measures do not adequately determine whether direct relationships between the environment and physical activity exist. Employing both a perceived and objective measure of the workplace environment would have strengthened the assessment, in addition to elaborated assessments of each level of the workplace environment. In addition, the psychometric properties of the PWES were assessed after the data collection for Aim Two, thus recommendations from the expert panel were not incorporated into the study instrument used in Aim Two.

Despite evidence for the content validity, internal consistency, and test-retest reliability of the PWES determined from assessments completed as Aim One, Streiner and Norman (1995) suggest those assessments are the minimum requirement for instrument development. In particular, the validity evidence for the PWES is limited as no concurrent validity estimations were made. This was in part due to two main reasons. First, there was a lack of available instruments assessing similar environmental elements (Sallis & Owen, 2002), and second, due to the PWES being incorporated into a larger randomized control trial assessing many other variables. In order to limit response burden, a limited amount of measurement items could be further included in the study instrument for Aim Two. The WPAAT (Plotnikoff et al. 2003) utilized to develop the PWES was too lengthy (i.e, 45 items) to be incorporated into the study questionnaire, and further, had dichotomous response options instead of Likert-type response options making it difficult to compare with the PWES to assess concurrent validity. Concurrent validity assessments of the PWES are recommended for future studies.

A further limitation is the study's two dependent measures were based on self-report inventories of physical activity behaviour. Further, the workplace physical activity measure was a single Likert-type item developed for this study. Although the workplace physical activity scale had high test-retest reliability as assessed in the Aim One study component, its content and concurrent validity was not assessed and may be limited. In addition, the cognitive measures only assessed general physical activity self-efficacy and outcome expectations. The study could be improved by developing and testing for workplace specific measures.

Another limitation is the cross-sectional study design; therefore causation of the predictor and criterion variables can not be determined. The study results do not permit one to conclude a change in the workplace environment to be more supportive of physical activity would affect the self-efficacy and physical activity behaviour of workers. Further, it is not known whether the PWES is sensitive enough to detect changes in the workplace environment.

Since this study was exploratory, caution must be taken in the interpretation of the results. With a large enough sample, significant findings can be inevitable (Tabachnick & Fidell, 1989). The large sample size in this case, created a situation where the degree of the associations were interpreted more critically than the significance level. This was demonstrated by a significant regression beta coefficient of .09 ($p<.01$) when the PWES only explained 1% of the variance in leisure-time physical activity. When interpreting the degree of the relationships observed in this study, the associations were small, indicating the observed relationships were minimal, thus the conclusions drawn regarding the relationships observed are more speculative then definitive.

Future directions for research

The influence of multi-level environments on physical activity behaviour is the least studied area in the physical activity promotion domain (Marcus & Forsyth, 1999). This study reports the development, and initial assessment of a scale warranting further evaluation and refinement. Studies should be conducted to compare these perceived measures to objective assessments of multiple levels of the environment in order to further develop such valid measurement scales. Similar succinct scales could also be created to assess other environmental settings such as the neighbourhood environment, and the home environment, in order to assess perceived multi-level environment components across different environment settings in large samples. Such brief measures help relieve response burden in survey research, and may aid in obtaining high quality data by the preservation of study participants.

The PWES could be adapted or lengthened to assess the workplace environment in the context of other health related behaviours such as smoking, and diet. Such investigation into the role the perceived workplace environment plays in health related behaviours would be valuable for planning and evaluating interventions targeting such behaviours. It could also be determined if different groups of employees perceive the same workplace environment differently (i.e., shift workers versus non shift workers, part-time workers versus full time workers, men versus women, blue collar versus white collar, older adults versus younger adults, different cultures, etc.). With changing work demographics to include a greater proportion of older adult workers, more part-time workers, and greater cultural diversity (Shephard, 2000; Stokols et al. 1996), such information would provide valuable insights into determining if perceptual differences exist between different groups of the workforce that may be of higher risk of physical inactivity.

Longitudinal analyses combined with an intervention targeting the multiple levels of the workplace environment would assess relationships between the environment, cognitive constructs and behaviour more thoroughly as it could be determined if a change in the environment was associated with a change in the perceptions of that environment, and further, to physical activity behaviour. In addition, a longitudinal design would assess the psychometric properties of the PWES more thoroughly as it could be determined if the PWES is adequately sensitive to detect changes in the workplace environment. Such longitudinal intervention study designs are recommended.

Characteristics of everyday environments, such as the workplace environment are expected to influence physical activity (Sallis et al. 1997). Furthermore, it has been suggested the perceived environment may have a greater influence on behaviour than the objective environment (Sallis et al.). Thus, the perceived workplace environment scales used in this study provide a starting place for assessing potential perceived environmental determinants. If associations between certain environmental characteristics and physical activity could be repeatedly demonstrated, interventions could be implemented targeting such environmental characteristics to create such supportive environments. It has been suggested that any research assessing ecological models could greatly add to the knowledge in this domain (Marcus & Forsyth, 1999), making future studies examining relationships between the environment and physical activity important contributions.

Recommendations for practice and policy

Since the measure developed in Aim One has some limitations discussed earlier, and the study design for Aim Two was cross-sectional, the findings would be prematurely utilized in practice and policy, but rather provide further evidence to a growing body of research in the development of ecological models. The findings of this study suggest psychological constructs derived from cognitive-based theories could be influenced by interventions in the multiple levels of the environment. By targeting the individual, social, community, organization, policy, and physical environments of the workplace, self-efficacy for engaging in physical activity could be enhanced, leading to an increase in physical activity behaviour. When added to the empirical literature assessing multi-level models in the physical activity domain, these study findings contribute to the understanding of ecological models, and may eventually aid in their uptake in practice as recommended in much of the physical activity literature (Gauvin, Levesque & Richard, 2001; Marcus & Forsyth, 1999; McLeroy, Bibeau, Steckler & Glanz, 1988; Polanyi, Frank, Shannon, Sullivan & Lavis, 2000; Sallis & Owen, 2002).

The PWES developed as Aim One of this study could eventually be used by practitioners and workplaces to assess employees' perceptions of their workplace environment. The scale is simple to complete, making it an easy global assessment measure to employ. This was demonstrated in the study by the small amount of missing data on the measure. The scale was also slightly associated with workplace physical activity and self-efficacy of employees as determined at the item level with Pearson correlations, and the construct level with regression analyses. Even though the PWES was used as a global construct to simplify the analyses and reporting for Aim Two, the

PWES could be examined at the item level. With further refinement, the short scale could be a useful instrument for the planning and evaluation process of workplace physical activity initiatives by identifying employee perceptions of each level the multi-level workplace environment. Such information could guide intervention resources to the areas perceived as the least supportive by employees.

Findings from this study suggest interventions targeting the workplace environment could be most effective at increasing the physical activity employees incorporate into their workday. This coincides with an active living approach that could be useful for increasing physical activity in today's busy lifestyle. Since employees spend on average, half of their waking hours at work and many jobs are now sedentary (Health Canada, 2001), any increase in physical activity during the workday could have beneficial health outcomes for the large employed adult population.

References

Bandura, A. (1986). *Social Foundations of Thought and Action*, Prentice-Hall, Inc. New Jersey.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W.H. Freeman and Company.

Baranowski, T., Perry, C. L., & Parcel, G. S. (1997). How individuals, environments, and health behavior interact. In Glanz, K., Lewis, F. M., Rimer, B. K. (Eds.), *Health Behaviour and Health Education Theory, Research, and Practice. (2nd Ed.* pp. 153-178). San Francisco, California: Jossey – Bass.

Bargh, J. A., & Gollwitzer, P. M. (1994). Environmental control of goal-directed action: automatic and strategic contingencies between situations and behavior. *Nebraska Symposium on Motivation, 41,* 71-124.

Bauman, A., Sallis, J. F., Dzewaltowski, D. A. & Owen, N. (2002). Toward a better understanding of the influences of physical activity. The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine, 23,* 5-14.

Duncan, S. C., Duncan, T. E., Stryker, L. A., & Chaumeton, N. R. (2002). Neighborhood physical activity opportunity: a multi-level contextual model. *Research Quarterly for Exercise and Sport, 73,* 457-463.

Fein, A. J., Plotnikoff, R. C., Wild, T. C., & Spence, J. C. (in press). Perceived environmental context and the physical activity in youth. *International Journal of Behavioural Medicine.*

Fein, A. J., Plotnikoff, R. C., Wild, T. C., & Spence, J. C. (2003). An examination of adolescents' perceptions of the school environment related to physical activity. Submitted for publication.

Gauvin, L., Levesque, L., & Richard, L. (2001). Helping people initiate and maintain a more active lifestyle. A public health framework for physical activity promotion research. (Chapter 28). In Singer, R. N., Hausenblas, H. A., & Janelle, C. M (Eds.) *Handbook of Sport Psychology* (pp. 718-739). New York: John Wiley & Sons, Inc.

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54,* 1793-1812.

Godin, G., & Shepard, R. J. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Science, 10,* 141-146.

Health Canada. (2001). *Health Canada's business case for active living at work. Trends and impact - the basis for investment decisions.* Retrieved August, 25, 2003, from http://www.hc-sc.gc.ca/hppb/fitness/work/trends_e.html

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity: a review. *American Journal of Preventive Medicine, 22,* 188-199.

Lewis, B. A., Marcus, B. H., Pate, R. R. & Dunn, A. L. (2002). Psychosocial mediators of physical activity beahvior among adults and children. *American Journal of Preventive Medicine, 23,* 26-35.

Maddux, J. E. (1997). Habit, health, and happiness. *Journal of Sport & Exercise Psychology, 19,* 331-346.

Marcus, B. H., & Forsyth, L. H. (1999). How are we doing with physical activity? *American Journal of Health Promotion, 14,* 118-124.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15,* 351-377.

Norman, G. R., & Streiner, D. L. (1999). *PDQ Statistics* (2nd ed.). Hamilton: B.C Decker Inc.

Plotnikoff, R.C., Fein, A. J., Prodaniuk, T. R., & Milton, L. (2003). Development of an ecological assessment tool for a workplace physical activity program standard. Submitted for publication.

Polanyi, M. F. D., Frank, J. W., Shannon, H. S., Sullivan, T. J., & Lavis, J., N. (2000). Promoting the determinants of good health in the workplace. Poland, B. D., Green, L. W., & Rootman, I. (Eds.) Settings For Health Promotion Linking Theory and Practice. Sage Publications, 139-160.

Sallis, J. F., Johnson, M. F., Calfas, K. J., Caparosa, S., & Nichols, J. F. (1997). Assessing perceived physical environmental variables that may influence physical activity. *Research Quarterly for Exercise and Sport, 68,* 345-351.

Sallis, J. F., & Owen, N. (2002). In Glanz, K., Marcus Lewis, F., Rimer, B. K. (Eds.).*Health Behaviour and Health Education*. (3rd Ed.).

Shepard, R. J. (2000). Worksite health promotion and the older adult. *International Journal of Industrial Ergonomics, 25,* 465-475.

Spence, J., Lee, R., (2003). Toward a comprehensive model of physical activity. *Psychology of Sport and Exercise, 4,* 7-24.

Stokols, D., Pelletier, K. R. & Fielding, J. E. (1996). The ecology of work and health: research and policy directions for the promotion of employee health. *Health Education Quarterly, 23*, 137-158.

Tabachnick, B.G., & Fidell, L.S. (1989). *Using multivariate statistics*. (2nd ed.). New York: Harper & Row Publishers.

APPENDIX A – METHODS

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Chapter Overview

The purpose of this appendix is to provide a detailed description of methods and results pertaining to Chapter III and IV of this thesis. This appendix is presented in two main sections in accordance with the two aims of this thesis. The first section focuses on instrument development to addresses Aim 1 (to develop a scale to assess global perceptions of the workplace environment related to physical activity). The second section that comprises the study focuses on a mediation analysis described by Baron and Kenny (1986) to address Aim 2 (to examine relationships between a global ecological construct, self-efficacy and outcome expectations, and physical activity behaviour).

Section One: Instrument Development

Section Overview

Section One focuses on the development of a scale to assess the workplace environment on six different levels of an ecological model. This section is presented in three phases: Phase One - the initial development of the scale items is presented with a background of content development and a pilot test of the items; Phase Two - an assessment of the scale's content validity is conducted using an expert review methodology; Phase Three - a test-retest reliability assessment was completed on the scale along with a workplace physical activity measure used for this study.

PHASE 1: Item Development

Background

In order to develop a scale to assess the workplace environment, a multi-level workplace physical activity audit tool (WPAAT) developed by Plotnikoff, Fein, Prodaniuk & Milton (2003) was utilized. The WPAAT was designed to assess multi-level workplace physical activity programs using a framework based on McLeroy and colleague's (1988) ecological model for health promotion and ecological concepts for physical activity described by Sallis and Owen (1997). The WPAAT was developed over a three-year period that involved extensive content development through a comprehensive literature review, stakeholder and expert reviews, and small workplace trials, and is comprised of six ecological levels; individual, social, community, organization, policy, and physical environment (Plotnikoff et al). Table A.1 provides the content definitions for each level.

Table A.1. Content Definitions for each Ecological Level

individual	factors in the workplace addressing individual employee characteristics related to physical activity behaviour such as skills, knowledge, confidence, age, and gender
social	the influence of the corporate culture, social relationships, peer, and boss relationships related to physical activity behaviour of employees
community	how the workplace interacts, partners with, or utilizes other organizations, community-based resources or government bodies that may foster physical activity behaviour of employees
organizational	infrastructure, leadership, and desire of the workplace to promote physical activity, how the organization is structured
policy	the workplaces' policies regarding physical activity behaviour of employees
physical environment	the physical environment of the workplace including the buildings, workplace grounds, and surrounding area related to physical activity behaviour of employees

One question was developed for each of the six levels of the WPAAT to provide a scale of six questions in order to limit response burden in the existing study's assessment protocol. This also respects a general rule recommended by Tabachnick and Fidell (1989) to use the least amount of items as possible to assess a construct. Although the six-item scale may fall short of providing a detailed assessment, it may be appropriate for a global multi-level assessment of the perceived workplace environment.

The initial scale development process was in part deductive, as each single item had to represent an entire level of the workplace environment; the WPAAT (Plotnikoff et al. 2003) contained 4 to 6 items for each level. The content definitions (see Table A.1) of each of the six levels from the WPAAT guided the framing of the six items by modifying the main concept from each level of the WPAAT into single questions. A 5-point Likert-type response option scale was utilized for each item to provide a global assessment.

Pilot Test

The six questions were piloted by a convenience sample of 15 employed adults (18-55 years) comprised of men and women varying in age, background, and education level (high school diploma up to graduate degree). The 15 individuals were asked to read the items and comment on their comprehension of each item, and what thoughts the items provoked. Participants were also encouraged to make suggestions to make the questions clearer. This information was utilized to modify the wording of each item and to ensure each measure was comprehensible for the intended research population. The final six questions making up the Perceived Workplace Environment Scale (PWES) are shown in table A.2:

TABLE A.2. Items of the Perceived Workplace Environment Scale (PWES)

Item in the PWES	**Question**
Individual level item	How much information is provided in your workplace educating and/or encouraging employees about physical activity?
Social level item	Is there a positive social climate that encourages physical activity in your workplace?
Community level item	Has your organization used any services or resources in the community to support the physical activity of employees? (examples: local recreation centre, community events)
Organizational level item	How much organizational capacity (i.e. infrastructure, will, and leadership) is there in your workplace that promotes physical activity for employees?
Policy level item	Does your workplace have policies that promote the physical activity of employees? (examples: no meetings scheduled over lunch, subsidized memberships at a fitness centre)
physical environment level item	Are there convenient and appropriate facilities that you can access in order to do physical activity during the workday?

Note: Employees indicated their answers by circling the phrase and number they most agreed with on a 5-point response option scale (1= none; 5 =a great amount). These six items were used as a composite scale by adding the scores for each item and dividing by six.
(See Appendix B page 173)

PHASE 2: Expert Review

Sample

Three groups of five individuals were obtained from three different contexts. A minimum of five reviewers is required in order to conduct any statistical analyses between groups of reviewers (Dunn, Bouffard & Rogers, 1999). Dunn, Bouffard & Rogers further suggest a weakness in much published research utilizing expert reviews is a lack of detail in the description of the expert panel. Below is a detailed description of the expert reviewers used in this project.

The first group (n=5) were researchers who had published in peer-reviewed journals in the physical activity and environment domain. These researchers worked at Universities in Alberta, Ontario, and Australia. The sample consisted of two women and three men.

The second group (n=5) was comprised of professional practitioners with experience in workplace physical activity. All had attained bachelor degrees in a physical activity or occupational health area. Four out of the five practitioners had attained, or were working towards their Masters degree. Practitioners were from Alberta and Ontario. The sample consisted of all women.

The third group (n=5) consisted of employed individuals from the Edmonton area. These adults were employed full-time, in healthcare, education, information technology, or recreation and culture. The sample consisted of four women and one man.

Measures

Item Content Review Form (ICRF).

The Item Content Review Form (ICRF) was developed using a description of an Item Content Review Form described by Dunn, Bouffard & Rogers, (1999). The instrument was designed to assess how well each of the perceived workplace environment measures (PWES) represented the matching content definition for each level of the WPAAT. The instrument utilized a 5-point Likert-type scale ranging from (1) "poor representation" to (5) "excellent representation" for each of the measures. The ICRF also included a section encouraging written feedback on the measures for further clarification of the assessment, and to aid in improving the measures for future research. (See Appendix B page 166)

Procedure

A list of potential experts were identified through published literature, networks, and public domain information. Potential participants were emailed an information letter, consent form, and ICRF as an attachment. Individuals choosing to participate filled out the ICRF and then emailed it back to the principal investigator. All quantitative data were entered into an SPSS 10 database for analysis. Qualitative comments were summarized into categories for each item, and main points reported.

Data Analysis / Results

Six, One-Way ANOVA analyses were performed (one for each of the items in the ICRF) with the three groups of experts to determine the level of agreement between the three samples (i.e. researchers, workers, and practitioners). The one-way ANOVA statistical test will detect if there are any differences between the means of two or more samples (Ness Evans, 1998). SPSS 10 automatically calculates the homogeneity of variance using the Levene statistic, as the ANOVA statistical test assumes the variance of scores within each group is the same. If this assumption is violated, then the power of the F test is generally lower (Tabachnick & Fidell, 1989). Homogeneity of variance was supported for all items except the policy item (*p* = .04). Results from the six ANOVAS however, revealed there were no significant differences between the three sample groups (see Table A.3). Subsequently, no post hoc comparisons were made (Ness Evans, 1998). This analysis provides evidence there was consensus between the three groups of experts.

Table A.3. Means, Standard Deviations, and ANOVA Results

Variable*	Workers (n=5) Mean (SD)	Practitioners (n=5) Mean (SD)	Researchers (n=5) Mean (SD)	F	p
individual	3.6 (.9)	2.4 (1.7)	3.4 (1.5)	1.05	.38
Social	4.0 (1.0)	3.8 (.8)	3.4 (1.1)	.47	.64
Organization	4.4 (.6)	3.4 (1.1)	3.2 (1.1)	2.21	.15
Community	5.0 (.0)	4.6 (.9)	4.0 (.7)	2.92	.09
Policy	5.0 (.0)	4.6 (.9)	4.2 (.5)	2.40	.13
Physical environment	4.2 (.8)	4.2 (1.3)	3.6 (1.1)	.49	.63

*Note: variables were evaluated on a 5-point Likert type scale ranging from (1 = poor representation) to (5 = excellent representation)

To further assess the expert review data, descriptive statistics were assessed for the 5-point Likert-type scale responses of all participants combined ($N = 15$). The descriptive statistics revealed the following results: Approximately 70% of participants rated the individual item as a 'good' to 'excellent' representation of the content definition; approximately 90% of participants rated the social item as 'good' to 'excellent'; approximately 80% rated the organization item as 'good' to 'excellent'; approximately 85% rated the community item as 'good' to 'excellent'; approximately 90% rated the policy item as either a 'very good' or 'excellent'; and approximately 85% rated the physical environment item as 'good' to 'excellent' representation. The data were positively skewed for each item adding content validity evidence.

Qualitative Results.

Qualitative comments provided by reviewers on the ICRF were assessed for common themes and summarized below with examples. Not all items received comments from each reviewer. The comments added further interpretation to the data utilized in Section Two of this Methods chapter.

Individual level item:

- Overall, this item received a positive review. The one concern with this item was it only captured information provided to employees, however the content definition included other elements that addressed employee characteristics. Another concern was it asked whether employees receive information, but it did not address the quality of the information.

Researcher ID 105 "my only concern is that the construct description refers to factors (plural) and the item says information (which I'd interpret as singular)"

Researcher ID 103 "I would reword this to 'How much information is provided in your workplace that educates and/or encourages employees *about the benefits of* physical activity?"

Practitioner ID 302 "This question would assess how much information the individuals are receiving, but it would not assess the quality of the information"

Worker ID 202 "knowledge and education is one thing the workplace can target at the individual level so this seems to be a good measure"

Social level item:

- This item received a positive review. One factor for improvement could be the terminology and the clarity in the item. The breadth of the item could also create vague assessments of the general social climate.

Researcher ID 103 "suggest '….encourages *and supports participation in….*'
This question may need to expand on the definition of workplace to obtain a clearer response. Workplaces can be very large and impersonal, I imagine you would like to know how the immediate (colleagues, close co-workers, direct line of management) social climate may influence the individual rather than perceptions of the entire social climate, which may be influenced by level of bureaucracy, autonomy of work practices and more general views of the organisation."

Worker ID 205 "the term positive should be defined in this item"

Practitioner ID 302 "I think this captures what you are trying to get at"

Community level item:

- This item was described as straightforward and clear. Some suggestions for improvement however, were offered.

Worker ID 202 "this seems like a very easy question to answer, clearly represents the community level, and is quite objective"

Practitioner ID 302 "this is basically straightforward and should be easy enough to answer"

Practitioner ID 301 "Some workplaces hire fitness instructors from the community to give on site classes. You may want to use this as an example"

Organization level item

- This item received a positive assessment however there was some concern employees could have difficulty answering this item.

Researcher ID 103 "suggest adding '…*actively* promotes physical activity for employees – there may be lots of capacity but how well is it being used and who may be driving it?"

Worker ID 202 "seems like a great question, but I'm not sure at first what would qualify as a lot, and maybe the question is a bit subjective"

Practitioner ID 302 "this may be difficult for workers who are not involved in any decision making capacity to evaluate"

Policy level item

- This item did not receive many comments, but did get a positive quantitative review. One suggestion was provided.

Researcher ID 103 "I would suggest adding '....*actively* promote physical activity participation...', as there are many workplaces that may have policies but do not actively promote them to staff on a regular basis."

Worker ID 202 "seems very clear"

Physical environment level item

- This item received a positive review, however suggestions for improvement were provided

Worker ID 204 "may want to stipulate at the workplace so there is no confusion with community level partnerships"

Practitioner ID 302 "perhaps adding the word "safe" after appropriate would make this question even better"

Practitioner ID 303 "I think that you are asking two questions here. There may be convenient (i.e. on site) facilities but the facilities may not be appropriate) (i.e. may not have equipment that users want, or may be too small etc)"

PHASE 3: Test-Retest

Sample

For the test-retest assessment of the PWES, a sample of 23 adult employees was drawn from two workplaces in Alberta. The majority of participants (*N* =17) were obtained from a department in a large government organization, with the remaining 6 participants from various departments at a large University. The sample comprised 11 men and 11 women with one participant not indicating his or her sex.

Measures

Besides testing the reliability of the PWES, the workplace physical activity measure developed for this study was also assessed.

Workplace physical activity.

Physical activity incorporated into the workday was assessed with one question in order to reduce response burden. The item was designed for this study to be incorporated into a long questionnaire assessing many other cognitive constructs, leisure-time physical activity, dietary behaviour, and demographic information. The question asked participants the degree to which they try to incorporate physical activity into their workday. The question was as follows:

How much do you incorporate physical activity into your workday (e.g. during breaks, active commuting to and from work)? Participants responded on a 5-point option scale ranging from "none" (1) to "a great deal" (5). (See Appendix B page 183).

Procedure

The sample of 23 employees completed the PWES and the workplace physical activity measure on two different occasions, separated by a period of two weeks. Participants from the department within the large government office (N =17) were recruited through a contact at the workplace. The contact sent out an email to employees in the workplace informing them of the study and detailing how to participate. Interested employees were instructed to pick up study packages including an information letter, consent form, and the instrument in a labelled box in a specific location of the workplace. Another labelled box was provided for employees to return their completed questionnaires. The second questionnaire was provided to employees two-weeks later through the same workplace contact, and completed instruments were again returned to the labelled box.

University participants ($N = 6$) were recruited in an attempt to increase the sample size. E-mail addresses of University employees were obtained through networks and public domain information. Individuals were e-mailed the questionnaire on two occasions two weeks apart. Participants completed the questionnaire electronically and returned completed forms by email to the principal investigator. Data were analysed using SPSS 10 statistical software.

Data Analysis / Results

Since the PWES was used as a composite scale to create a global ecological construct, Cronbach's alpha was calculated to test internal consistency. This was done for time one and time two revealing standardized alphas of .81 at time one, and .85 at time two which were both acceptable (Streiner & Norman, 1995).

Streiner and Norman (1995) recommend the intraclass correlation coefficient as a robust assessment for determining test-retest reliability. The Intraclass Correlation determines the average correlation between pairs for time one and time two tests. An intraclass correlation coefficient for the PWES of .97 and for the workplace physical activity measure of .86 indicated the measures were stable between time one and time two.

Paired Sample T-test between means for time one and time two.

The paired sample t-test was conducted between means for time one and time two for the PWES construct and the workplace physical activity measure. The null hypothesis for the Paired Sample T-test is there is no difference between the average values for members of a pair (Norusis, 1999). If the null hypothesis is rejected (there is a difference between pairs), than test-retest reliability is not supported. The results of the assessment indicated there was no significant difference between means for time one and time two for both the PWES and workplace related physical activity. See Table A.4 for a summary of the results.

TABLE A.4. Paired sample t-test between means for time one and two

Measures	Time 1 Mean (SD)	Time 2 Mean (SD)	t	P
PWES Construct	2.34 (0.82)	2.43 (0.81)	-1.62	0.12
Workplace PA	2.96 (0.98)	2.96 (0.93)	0.00	1.00

Section Two: Mediation Analysis

Section Overview

This section focuses on assessing relationships between cognitive constructs (self-efficacy and outcome expectations), the PWES, and physical activity behaviour. This was a cross-sectional study design utilizing a baseline sample of employees from an intervention study. The measures for this thesis project were incorporated into the baseline questionnaire containing other physical activity, cognitive, and demographic measures. A series of data screening procedures were undertaken prior to a series of regression analyses performed to determine (1) if the PWES was related to physical activity behaviour of workplace employees, and (2) to determine if any relationship between the PWES and physical activity behaviour was mediated by self-efficacy and outcome expectations.

Recruitment and Sample

This study was conducted as part of a randomized controlled trial (RCT) of a workplace physical activity intervention (Plotnikoff, Courneya, Spence, Birkett, & Marcus, 2003). This study utilized data from the baseline segment of the RCT rather than subsequent assessments to eliminate the chance of effects from the workplace physical activity intervention. To obtain the sample, the study was advertised by email and posters in three large Alberta organizations for two weeks prior to the actual distribution of questionnaires.

Employees from each organization were sent questionnaires to their workplace address in May 2002. Every employee was sent a research package (containing the information letter, consent form, and questionnaire) within the internal mail system of his or her workplace. People who chose to participate returned their completed questionnaire in an envelope provided within the internal workplace mail system that was subsequently couriered en masse to the research lab. A total of 8000 questionnaires were sent, with 897 returned and sufficiently completed for analysis (response rate of 11.2%). The total sample was comprised of sub-samples from three organizations: (1) a regional health authority (*n* = 409), (2) a post secondary educational institution (*n* = 170), and (3) city workers from a large Alberta city (*n* = 318).

The total sample's mean age was 42.2 years (*SD* = 9.91) and comprised a greater number of women than men (661 [74%] women, and 232 [26%] men, with 4 individuals not indicating sex). 73% of participants were full-time employees, 25% were part-time workers, 5 participants were volunteer workers, and 9 did not indicate employment type. The sample was comprised of 25% shift workers.

Measures

Perceived Workplace Environment (PWES).

The PWES described in Section One of this chapter assessed the perceived workplace environment in the context of physical activity. (See Appendix B page 173).

Self-Efficacy.

A validated nine-item self-efficacy scale assessed one's confidence for doing physical activity in different situations (e.g., when tired, when it becomes boring, etc.) on a 5-point scale ranging from 1 (not at all confident) to 5 (extremely confident) (Plotnikoff, 2002; Plotnikoff, Blanchard, Hotz, & Rhodes, 2001). The self-efficacy construct was calculated by adding the scores for each item, and then dividing by nine. (See Appendix B page 179).

Outcome Expectations.

For the purposes of this study, the general measure of outcome expectations was obtained by asking individuals how much various statements about outcomes to physical activity behaviour would influence their decision to do regular physical activity. Responses were measured on a 5-point Likert-type scale from (1) "not at all" to (5) "very much". Both negative and positive assessments were obtained and calculated separately as outcome expectations (pros = 5 items), and outcome expectation (cons = 6 items; e.g. *outcome expectation pro*: Physical activity would help me reduce tension or manage stress; *outcome expectation con*: Physical activity would take too much of my time). The constructs were calculated by adding up the scores for all responses on the Likert type scale for pros and cons separately, and then dividing by the total number of questions for each (pros and cons). The validity and reliability of these measures are reported in Plotnikoff et al. (2001) and Plotnikoff (2002). (See Appendix B page 180)

Leisure-Time Physical Activity.

Leisure-time physical activity was measured using a modified Godin Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985). This instrument asked participants how many times per week they engage in strenuous, moderate, and mild physical activity. The definitions for these three levels of intensity were defined in the following way: (1) Strenuous physical activity: (heart beats rapidly, sweating) Examples included: running, jogging, hockey, soccer, cross country skiing, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance, heavy weight training; (2) Moderate physical activity: (not exhausting, light perspiration) Examples included: fast walking, baseball, tennis, easy bicycling, swimming, volleyball, popular and folk dancing; (3) Mild physical activity: (minimal effort, no perspiration) Examples: easy walking, yoga, archery, bowling, golf.

Study participants were instructed to only include activities with a duration of 10 minutes or more. This differs from the original Godin instrument that utilized a 15 minutes or more requirement. The 10 minutes or more criterion was used to coincide with physical activity recommendations of Canada's Physical Activity Guide (Health Canada, 2000). The Godin instrument specifies the metabolic equivalent (times the resting metabolic level) (MET) values for strenuous physical activity as 9 METS; moderate physical activity as 5 METS; and mild physical activity as 3 METS (Godin & Shepard, 1985). The total leisure activity score was calculated using the following formula: $LPA = (N \cdot MET)_{light} + (N \cdot MET)_{moderate} + (N \cdot MET)_{hard}$

Where: LPA = Total leisure physical activity score
N = number of physical activity bouts per week lasting 10 minutes or longer

(See Appendix B page 182)

Workplace physical activity.

Physical activity incorporated into the workday was assessed with one question in order to reduce response burden. The item was designed for this study to be incorporated into a long questionnaire that assessed many other cognitive constructs, leisure-time physical activity, dietary behaviour, and demographic information. One Likert-type item assessed the degree to which respondents incorporate physical activity into their workday by the following question:

"How much do you incorporate physical activity into your workday (e.g. during breaks, active commuting to and from work)?" Participants responded on a 5-point option scale ranging from "1 = none" to "5 = a great deal". This item was assessed for test re-test reliability in section one of this method Chapter and was shown to be stable between time one and time two (intraclass correlation coefficient (.86). (See Appendix B page 183 for the instrument).

Data Screening

A series of data screening methods were implemented as described in Tabachnick & Fidell (1989) for ungrouped data (pp. 89). Table A.5 provides a checklist of procedures considered and executed.

TABLE A.5. Checklist for Screening Data

1.	Inspect univariate descriptive statistics for accuracy of input
	a) Out-of-range values
	b) Plausible means and standard deviations
	c) Coefficient of variation
2.	Evaluate amount and distribution of missing data: deal with problem
3.	Identify and deal with non-normal variables
	a) check skewness and kurtosis, probability plots
	b) Transform variables (if desirable)
	c) Check results of transformation
4.	Identify and deal with outliers
	a) Univariate outliers
	b) Multivariate outliers
5.	Check pairwise plots for nonlinearity and heteroscedasticity
6.	Evaluate variables for multicollinearity and singularity

Univariate Descriptive Statistics and Outlier Screening.

Since all measures of this study utilized scaled responses (except Leisure-Time Physical Activity), all data appeared to fall in a normal range. Descriptive statistics revealed similar means and standard deviations for all three sub-samples (health authority, educational institution & city workers). Means and standard deviations were plausible for all constructs except leisure-time physical activity, which had very large standard deviations indicating possible outliers.

Standardized Z scores were assessed for all variables for the total sample (*n* = 897). Standardized Z scores falling three or more standard deviations from the mean are extreme as 99% of cases fall within ± 2.58 standard deviations from the mean (Ness Evans, 1998). For large samples however, it is common to have Z scores over three standard deviations (Tabachnick & Fidell, 1989).

The only measure containing outliers further than 4 standard deviations from the mean was leisure-time physical activity in which standardized Z scores were found to be 11 standard deviations from the mean. Such extreme outliers were removed (Bernard, 2000; Tabachnick & Fidell, 1989), case by case; with standardized Z scores being recalculated after each case was removed, until no outliers remained. A total of 15 cases were removed from the data comprising only 1.7% of the sample. Table A.6 provides a summary of descriptive statistics for the Leisure-time physical activity data before and after the removal of outliers.

TABLE A.6. Descriptive Statistics for Leisure-time Physical Activity

			Before the removal of outliers				
N	Min	Max	Mean	SD	Median	Skewness	Kurtosis
869	.00	1185.00	42.76	63.06	36.00	13.69	241.05
			After the removal of outliers				
N	Min	Max	Mean	SD	Median	Skewness	Kurtosis
854	.00	136.00	37.95	26.05	35.00	.88	.73

Missing Data.

The preliminary analysis of missing data involved an assessment of each variable for each sub-sample (i.e., (1) regional health authority, (2) educational institution, & (3) city workers). There were minimal missing data across all variables with the highest value being 4.8% for leisure-time physical activity in the educational institution sub-sample. Missing data for all other variables was below 4%, with many variables having no missing data (See Table A.8 on page 148). Dealing with missing data using the default method of SPSS 10 (to remove it from analysis) was chosen as missing data were minimal, randomly distributed throughout the data set, and the sample sizes were large.

Skewness and Kurtosis.

An underlying assumption of inferential analyses is a normal distribution of data (Tabachnick & Fidell, 1989). Skewness and kurtosis are two components of normality; skewness being the degree to which the mean falls in the centre of the distribution and kurtosis showing how peaked the distribution is (Tabachnick & Fidell).

Skewness and kurtosis values were assessed for each of the six PWES items and the global PWES construct, cognitive constructs, and physical activity behaviour for the full sample and each of the three organization sub-samples. All skewness and kurtosis values were close to zero indicating the distributions of the data were all reasonably normal for subsequent statistical analyses. Results of the assessment are presented in Table A.7.

TABLE A.7. Skewness and Kurtosis Values for variables and constructs

	Full Sample		**(1) Health Authority**		**(2) Educational Institution**		**(3) City Workers**	
Measures	Skew	Kurt	Skew	Kurt	Skew	Kurt	Skew	Kurt
Individual	.22	-.58	.33	-.42	-.01	-.86	.10	-.50
Social	.07	-.70	.16	-.76	-.02	-.50	-.09	-.69
Organization	.31	-.58	.27	-.70	-.24	-.65	.45	-.30
Community	.28	-.64	.37	-.59	.10	-.84	.18	-.59
Policy	.42	-.72	.52	-.65	.42	-1.13	.23	-.59
Physical Env.	-.26	-.93	-.20	-.57	-1.41	1.95	.14	-1.13
Leisure PA	.88	.73	.77	-.02	.92	1.51	.90	-.75
Workplace PA	.44	-.68	.57	-.40	.31	-1.00	.35	-.74
Self-Efficacy	.06	-.24	.18	-.19	.00	-.18	-.07	-.26
Outcome Pro	-.76	.66	-.80	.73	-.76	.48	-.72	.76
Outcome Con	.58	-.24	.45	-.53	.59	-.13	.66	-.08
PWES construct	.41	-.28	.42	-.16	.02	-.46	.43	-.31

Combining Data from Three Sub-Samples.

Data from the three sub-samples (i.e., (1) health authority, (2) educational institution, (3) city workers), were assessed for compatibility as one sample to simplify the statistical analyses and reporting. ANOVA analyses were conducted to assess similarity across different construct means revealing significant F-values for all measures except self-efficacy and outcome expectations pros. The Scheffe post-hoc test, considered robust for comparing samples of different size (Ness Evans, 1998), was administered revealing the educational institution differed from the other two sub-samples for outcome expectation cons, leisure-time physical activity, and workplace physical activity. Further, all three sub-samples differed on the PWES. Table A.8 provides a summary of results.

TABLE A.8. ANOVA Results and Descriptive Statistics

Measures	Organization	Mean	SD	N	Missing data	F	p
Global Ecological Construct	City workers	2.78	.86	307	5	38.47	.00
	Health Authority	2.47	.73	385	19		
	Educational Inst.	3.11	.87	164	2		
	Total	**2.70**	**.84**	**856**	**26**		
Self-efficacy	City workers	3.22	.83	309	3	2.25	.11
	Health Authority	3.12	.82	399	5		
	Educational Inst.	3.27	.89	164	2		
	Total	**3.18**	**.84**	**872**	10		
Outcome expectations (pros)	City workers	3.94	.76	311	1	1.03	.36
	Health Authority	4.02	.75	403	1		
	Educational Inst.	4.00	.79	166	0		
	Total	**3.99**	**.76**	**880**	2		
Outcome expectations (cons)	City workers	1.93	.71	311	1	6.76	.00
	Health Authority	1.99	.65	398	6		
	Educational Inst.	1.77	.59	165	1		
	Total	**1.93**	**.67**	**874**	8		
Workplace physical activity	City workers	2.56	1.15	312	0	3.66	.03
	Health Authority	2.34	1.12	402	2		
	Educational Inst.	2.52	1.24	166	0		
	Total	**2.45**	**1.16**	**880**	2		
Leisure-time physical activity	City workers	40.68	27,76	308	4	7.15	.00
	Health Authority	34.30	24.24	388	16		
	Educational Inst.	41.59	25.92	158	8		
	Total	**37.95**	**26.05**	**854**	28		

Linearity and Homoscedasticity/Heteroscedasticity.

An assumption of multivariate statistics is there is linearity between all pairs of variables with only linear relationships being analyzed and any substantial non-linear relationships being ignored (Allen, 1997; Tabachnick & Fidell, 1989). Linearity can be assessed graphically using residual or bivariate scatterplots between paired variables with an oval-shaped appearance indicating linear relationships (Tabachnick & Fidell).

Homoscedasticity, refers to the degree of similarity in variability of scores between variables, and heteroscedasticity, refers to a non-normal distribution in one or both variables, that can also be evaluated through bivariate scatterplots (Tabachnick & Fidell).

Bivariate scatter plots were observed between predictor variables (cognitive predictors and the PWES) and criterion variables (physical activity measures). The bivariate scatter plots revealed relatively normal distributions, however, no strong relationships were observed between any of the predictor and criterion variables indicating strong associations would not be apparent. The strongest relationship appeared to exist between self-efficacy and leisure-time physical activity. Bivariate outliers were identified, however, Tabachnick and Fidell (1989) suggest statistical methods of identifying multivariate outliers is preferred to graphical methods. Multivariate outliers are dealt with in the regression diagnostics section (page 152).

Internal Consistency Assessment of Scales.

Cronbach's alpha assesses how well a group of items are measuring a single construct (Streiner & Norman, 1995). Cronbach's coefficient alpha was calculated to determine the internal consistency of the six-item PWES, the published composite scales for self-efficacy and outcome expectations pros and cons (Plotnikoff et al, 2001; Plotnikoff, 2002). The reliability coefficients (alpha) for the PWES, self-efficacy, outcome expectation pros, and outcome expectation cons were .83, .92, .81, and .74 respectively, which were all acceptable (Streiner & Norman). Table A.9 provides the means, standard deviations, alpha when the item is deleted, and the reliability coefficients for each construct.

TABLE A.9. Internal Consistency Statistics

Items	Mean (SD)	Alpha if item deleted
PWES		
Individual level	2.6 (1.0)	.80
Social level	2.7 (1.1)	.79
Organization level	2.6 (1.1)	.78
Community level	2.6 (1.1)	.80
Policy level	2.4 (1.2)	.81
Physical environment	3.3 (1.3)	.84
PWES	**Alpha =**	**.83**
Self-efficacy		
Confidence when tired	3.3 (1.0)	.91
When in bad mood	3.4 (1.1)	.91
When Going alone	3.8 (1.1)	.92
When boring	3.1 (1.1)	.91
When no improvements	3.3 (1.0)	.91
When time demands	2.6 (1.1)	.92
When stiff or sore	3.4 (1.0)	.91
When bad weather	3.3 (1.1)	.92
When ill	2.5 (1.0)	.92
Self-efficacy	**Alpha =**	**.92**
Outcome Expectations Pros		
PA would reduce tension/stress	3.9 (1.0)	.75
Increase confidence in health	4.2 (0.8)	.76
Help me sleep better	3.7 (1.1)	.76
Create a positive outlook	4.0 (1.0)	.73
Help me control weight	4.0 (1.1)	.84
Outcome exp. pros	**Alpha =**	**.81**
Outcome Expectations cons		
PA would take too much time	2.4 (1.1)	.66
Less time for family/friends	2.1 (1.1)	.67
Would be too tired	2.2 (1.1)	.68
I would look awkward	1.6 (0.9)	.74
Would cost too much	1.8 (1.0)	.72
Would cause injury	1.5 (0.9)	.74
Outcome exp. cons	**Alpha =**	**.74**

Correlations between the PWES, physical activity and cognitive constructs.

Pearson correlations were calculated between each PWES item and the global PWES construct, and all other variables. All PWES items were moderately to highly correlated [range = .30 to .63 (*p* =.01)] adding further justification for their employment as a global PWES construct. Leisure-time physical activity was only slightly correlated with each PWES item (range = .07 to .12), and the PWES construct [.13 (*p* =.01)], and was moderately correlated to the cognitive constructs of self efficacy [.47 (*p* =.01)], outcome expectations pros [.20 (*p* =.01)], outcome expectations cons [.-.25 (*p* =.01)], and workplace physical activity [.39 (*p* =.01)]. The workplace physical activity measure was moderately correlated to each PWES item (range = .14 to .19), and the global PWES construct [.23 (*p* =.01)] and self-efficacy [.37 (*p* =.01)], and slightly correlated to outcome expectation pros [.17 (*p* =.01)], and outcome expectation cons [-.18 (*p* =.01)]. See Table A.10 for the correlation matrix.

TABLE A.10. Pearson Correlations between the PWES, physical activity measures, and cognitive constructs.

	LPA	WPA	SE	PRO	CON	*IND*	*SOC*	*COM*	*ORG*	*POL*	*PHY*	PWES
LPA	1.00	.39**	.47**	.20**	-.25**	.07*	.12**	.08*	.11**	.09**	.08*	.13**
WPA		1.00	.37**	.17**	-.18**	.19**	.17**	.14**	.19**	.17**	.16**	.23**
SE			1.00	.31**	-.44**	.15**	.18**	.10**	.16**	.14**	.18**	.20**
PRO				1.00	-.13**	.05	.06	.03	.05	.04	.13**	.08*
CON					1.00	-.18**	-.09**	-.14**	-.10**	-.07*	-.14**	-.15**
IND						1.00	***.57*****	***.46*****	***.62*****	***.41*****	***.33*****	***.75*****
SOC							1.00	***.47*****	***.63*****	***.41*****	***.38*****	***.77*****
COM								1.00	***.54*****	***.56*****	***.27*****	***.74*****
ORG									1.00	***.46*****	***.46*****	***.83*****
POL										1.00	***.30*****	***.72*****
PHY											1.00	***.64*****
PWES												1.00

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Note: PWE variables comprising the PWES are presented in bold italics

LPA= Leisure Time Physical Activity
WPA= Workplace Physical Activity
SE= Self-Efficacy
PRO= Outcome Expectations Pros
CON= Outcome Expectations Cons
IND= Individual Level Item
SOC= Social Level Item
COM= Community Level Item
ORG= Organization Level Item
POL= Policy Level Item
PHY= Physical Environment Item
PWES= Global Ecological Construct

Regression Diagnostics

The following regression diagnostic elements are recommended by Tabachnick and Fidell (1989), and are described for the following analyses.

1) Ratio to Cases of Independent Variables.

It is desirable to have at least twenty times more individuals in the sample than independent variables when conducting multiple regression analyses (Tabachnick & Fidell, 1989). There were approximately 400 times more individuals in the sample then independent variables in any one regression analysis, eliminating concerns regarding a problematic small sample size. A large sample is desirable when measurement error is anticipated due to unreliable variables (Tabachnick & Fidell). Since this study was somewhat exploratory utilizing new measures for the perceived workplace environment and workplace physical activity, the large sample met this recommendation.

A sample that is too large however, can also create significant findings even when the independent variable predicts very small variance in the dependent variable (Tabachnick & Fidell, 1989) and should be considered when interpreting findings of these analyses, thus the degree of the relationships were evaluated more then the significance level. By utilizing one large sample however (as apposed to assessing each sub-sample), the analyses and reporting were simplified. Each sub-sample (i.e., Health Authority, Educational Institution, and City Workers), was evaluated via the mediation protocol separately in the initial data analyses revealing similar findings as the entire sample combined, thus it was decided to report the full sample only for parsimonious reporting.

2) *Outliers.*

Univariate outliers were originally discovered in the leisure-time physical activity data in the initial data screening by assessing standardized Z scores and 15 cases with extreme scores were subsequently removed. When conducting regression analyses with SPSS 10, multivariate outliers are revealed by casewise diagnostics after each regression. A further 16 cases were discovered and removed from the regression analyses as they did not fit the regression model (Tabachnick & Fidell, 1989). Since the sample size was large, the removal option for univariate and multivariate outliers was the preferred choice comprising only 3.5% (i,e., 31 cases) of the total sample.

3) *Collinearity.*

Examining the correlation matrix allowed for a pre-assessment of potential multicollinearity between variables. Tolerance tests for multicollinearity were conducted with each regression analysis to determine if predictor variables entered into the equation were not overly correlated. Only two predictor variables were entered into each regression equation (i.e., site dummy variables and the PWES construct or cognitive constructs).

With the mediation model, it is presumed the predictor variable (i.e., PWES) causes the mediator (i.e., self-efficacy) (Baron & Kenny, 1986), and therefore, these two variables are correlated (Pearson $r = .23$ at $p = < 0.01$). This automatically causes multicollinearity when both are included in regression analyses, and reduces the power of the model (Baron & Kenny). This was indicated in the tolerance test as collinearity was occurring between self-efficacy and the PWES (Tabachnick & Fidell, 1989). Thus, Baron and Kenny recommend observing the absolute size of the coefficients in Step Four of the mediation analysis, as well as the significance in order to determine if mediation is occurring.

4) Normality, Linearity, Homoscedasticity, and Independence of Residuals.

Histograms, normal probability plots and residual scatter plots were observed for each regression equation conducted. The histogram revealed a normal distribution of data for each equation. The normal probability plot revealed a normal distribution of residuals in each regression analysis. The residual scatter plots were acceptable for each regression equation (Tabachnick & Fidell, 1989).

Mediation Analysis and Results

Regression analyses determine the degree to which a score on one variable can be predicted from the score of another variable (Allen, 1997; Tabachnick & Fidell, 1989). To test for the mediation of self-efficacy and outcome expectations on the relationship between the PWES and physical activity behaviour, four regression equations (four steps) were completed as described by Baron and Kenny (1986).

Earlier data screening procedures had determined the sub-samples (i.e., (1) health authority, (2) educational institution, and (3) city workers) differed across outcome expectations cons, physical activity and the PWES. Therefore, to test the effect of site on the relationships between the predictor and criterion variables, two dummy variables were created for site with the values 1 and 0. This was done by creating two new variables for site and assigning them values of zero, then using the "IF" function in SPSS

10, to replace the zeros with ones for the appropriate conditions (e.g. if site = 1 then Health Authority = 1; if site = 2 then city = 1; if site = 3 then educational institution = 1). Only two indicator variables were included in each equation, as the third does not add any further explanation (Allen, 1997). This procedure controlled for any possible site effects on the four-step mediation analyses described below.

Step One: Self-efficacy and Outcome Expectations regressed on the PWES.

In order to move on to Step Two of the mediation analyses, the criterion set forth by Baron and Kenny (1986) is the predictor variable (PWES) must be significantly associated to the mediator (social-cognitive variables). The dummy variables for site were included in hierarchical regressions as block one, with the PWES being included as block two.

The entire model explained 4% of the variance in self-efficacy. Site explained 0% of the variance, with the PWES explaining the entire 4% ($\beta = 0.2$ [$p =. 01$]). The entire model explained only 1% of the variance in outcome expectation pros. Site had no association with outcome expectation (pros) ($R^2adj = .00$) with the PWES explaining the entire 1% ($\beta =0.1$ [$p =. 01$]). The entire model explained 3% of the variance in outcome expectation cons. Site explained 2% of the variance, with the PWES adding an additional 1% ($R^2adj = .03$) ($\beta =-.12$ [$p =. 01$]). See Table A.10 for a summary of these regressions.

Table A.10. Hierarchical Regressions: Self-efficacy and Outcome Expectations regressed on the PWES

Self-efficacy (n=836)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.00	.01	2.62		
• Site one				.06	
• Site two				.08	
Block 2	.04	.04	30.81*		
• PWES					.20*

Outcome Exp. Pros (n=844)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.00	.00	1.00		
• Site one				-.05	
• Site two				-.01	
Block 2	.01	.01	8.04*		
• PWES					.10*

Outcome Exp. Cons (n=840)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.02	.02	7.59*		
• Site one				-.05	
• Site two				-.14*	
Block 2	.03	.01	12.22*		
• PWES					-.12*

*p < .01

Note: Beta 1 and Beta 2 are the standardised regression coefficients for the linear equations represented by blocks one and two.

Site had a minimal effect on the relationships observed in the full sample for self-efficacy and outcome expectation pros, but did have an effect on the already small relationship between the PWES and outcome expectations cons. In the mediation analysis, it is assumed the predictor variable causes the mediator (Baron & Kenny, 1986). The association between the PWES and the cognitive constructs were small. Self-efficacy had the strongest association without site effects; therefore it was decided to continue on to the next step of the mediation analysis with self-efficacy as the only potential mediator.

Step Two. Physical Activity regressed on the PWES.

The second regressions were completed between the PWES and physical activity behaviour. In order to continue on to Step Three of the mediation analysis, the PWES must significantly be associated with physical activity behaviour (Baron & Kenny). The dummy variables for site were included into hierarchical regression models as block one, and the PWES as block two.

The full model accounted for 2% of the variance in leisure-time physical activity. Site explained 1% of the variance, with the PWES explaining only a further 1% (β =. 09 [*p* =. 01]). The entire model explained 5% of the variance in workplace physical activity. Site explained 1% of the variance, with the PWES adding a further 4% (β =. 23 [*p* =. 01]). See Table A.11 for the results of these equations.

Table A.11. Hierarchical Regression: Physical Activity regressed on the PWES

Leisure Time PA (n=820)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.01	.02	6.37*		
• Site one				.11*	
• Site two				.11*	
Block 2	.02	.01	6.45		
• PWES					.09*

Work Time PA (n=846)	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.01	.01	3.33		
• Site one				.09	
• Site two				.07	
Block 2	.05	.05	42.53*		
• PWES					.23*

$^*p < .01$

Note: Beta 1 and Beta 2 are the standardised regression coefficients for the linear equations represented by blocks one and two.

Since the degree of the relationship between the PWES construct and leisure-time physical activity was very small ($R^2adj = .01$) there would be only a negligible relationship to potentially mediate. It was decided, therefore, not to include leisure-time physical activity in subsequent steps of the mediation analyses. The mediation analyses continued on to Step Three with workplace related physical activity as the only dependent variable.

Step Three: Physical activity regressed on the mediator.

In order to proceed with the mediation analysis, there must be a significant relationship between the mediator and physical activity behaviour (Baron & Kenny, 1986). The next regression was completed with self-efficacy as the predictor and workplace physical activity as the criterion variable. The site dummy variables were included in hierarchical regression as block one with self-efficacy as block two.

The full model explained 14% of the variance in workplace related physical activity. Site explained 1% of the variance, with self-efficacy explaining an additional 13% ($\beta = .36$ [$p = .01$]). Table A.12 provides a summary of the results.

Table A.12. Self-efficacy as Predictor (n=860)

Work Time PA	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.01	.01	3.11		
• Site one				.08	
• Site two				.06	
Block 2	.14	.13	129.39*		
• Self-efficacy					.36*

*p < .01

Note: Beta 1 and Beta 2 are the standardised regression coefficients for the linear equations represented by blocks one and two.

Site played a minimal role in the relationship between self-efficacy and workplace related physical activity. Self-efficacy was moderately associated with workplace related physical activity.

Step Four: Physical activity regressed on the mediator and the PWES.

The final regression was completed between the PWES, the potential mediator (self-efficacy), and workplace physical activity. Self-efficacy must be significantly associated with the physical activity behaviour variable in this equation (Baron & Kenny, 1986). The association of the PWES with physical activity behaviour must be less in this equation then in Step Two, and will show perfect mediation if the PWES has no effect on physical activity behaviour when self-efficacy is controlled (Baron & Kenny). Site was not included in this regression as it was determined by the previous steps to have minimal influence on the relationships observed between the variables utilized in this equation. Self-efficacy was entered into the hierarchical equation as block one, with the PWES being entered as block two.

The entire model explained 16% of the variance in the workplace-related physical activity variable. Self-efficacy explained 13% of the variance, with the PWES explaining a further 3%. Table A.13 shows the results of this equation.

Table A.13. Self-efficacy and the PWES Construct as Predictors (n=836)

Work Time PA	R^2adj	R^2 *change*	F *change*	Beta 1	Beta 2
Block 1	.13	.13	128.32*		
- Self-efficacy				.37*	
Block 2	.16	.02	23.27*		
- PWES				*Step Two* $\beta = .23^*$	.16*

$^*p < .01$

Note: Beta 1 and Beta 2 are the standardised regression coefficients for the linear equations represented by blocks one and two.

The results indicate there was slight mediation by self-efficacy on the relationship between the PWES and workplace-related physical activity, as there was a reduction in the beta value of this relationship from $\beta = .23$ to $\beta = .16$. Further, the R^2adj value for the PWES also declined from 0.4 in step two of the mediation analysis, to 0.3 in this final regression.

References

Allen, M. P. (1997). *Understanding Regression Analysis.* New York: Plenum Press.

Baron, R. M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bernard, H. R. (2000). Scales and scaling. In, *Social Research Methods. Qualitative and Quantitative Approaches* (pp. 285-316). Thousand Oaks: Sage Publications, Inc.

Godin, G., & Shepard, R. J. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Science, 10,* 141-146.

Ness Evans, A. (1998). *Using basis statistics in the social sciences* (3rd ed.). Scarborough, Ontario: Prentice-Hall Canada Inc.

Norman, G. R., & Streiner, D. L. (1999). *PDQ Statistics* (2nd ed.). Hamilton: B.C Decker Inc.

Norusis, M J. (1999). *SPSS 9.0 Guide to Data Analysis.* New Jersey: Prentice Hall.

Plotnikoff, R. C. (2002). The development of social-cognitive measures in the exercise domain: Issues and challenges. *Measurement in Physical Education and Exercise Science, 6,* 255-261.

Plotnikoff, R. C., Blanchard, C., Hotz, S. B., & Rhodes, R. (2001). Validation of the decisional balance scales in the exercise domain from the transtheoretical model: a longitudinal test. *Measurement in Physical Education and Exercise Science, 5,* 191-206.

Plotnikoff, R. C., Courneya, K., Spence, J., Birkett, N., & Marcus, B. (2003). [A randomized control trial of physical activity interventions in Alberta]. Unpublished raw data.

Plotnikoff, R.C., Fein, A. J., Prodaniuk, T. R., & Milton, L. (2003). Development of an ecological assessment tool for a workplace physical activity program standard. Submitted for publication.

Streiner, D. L., & Norman, G. R. (1995). *Health measurement scales. A practical guide to their development and use* (2nd ed.). New York: Oxford University Press.

Tabachnick, B.G., & Fidell, L.S. (1989). *Using multivariate statistics.* (2nd ed.). New York: Harper & Row Publishers.

APPENDIX B – Information Letters, Consent Forms, and Instruments

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UNIVERSITY OF ALBERTA

Study Title: Item Content Review of a Workplace Physical Activity Scale

Dear (Participants Name),

I am conducting a review of six questions that have been developed for workplace physical activity research. The six questions are to be used for part of my Masters Thesis project. The questions have been developed to provide a measure of the perceptions employees have of the multiple levels of their workplace environment related to physical activity. The main objective of this small study is to further assess the validity of the questions.

I am requesting your participation to evaluate the quality of these questions in order for me to get an indication of their content validity, and also to refine and improve the questions. The questions have been designed to be short and easy to fill out. Ultimately they will be used to obtain a general assessment of employees' perceptions of their workplace environment with regards to physical activity. There is a lack of such measurement instruments published in the literature, so the development of these questions will be valuable to workplace physical activity research.

The attachment to this email contains an Item Content Review Form for you to review the six questions and evaluate them. There is also space for you to provide any written recommendations to help improve the questions. Your participation in this project will consist of completing the Item Content Review Form attached, and emailing or faxing it back to the Principal Investigator. Your total time commitment will be approximately 20 minutes. Participation in this study should be done during your free time, and not as a part of your work. Directions for completing the Item Content Review Form are on the attached document.

Your participation in this research study is voluntary and is very much appreciated. If at any time during the study you do not want to answer a question, you have the right to not answer it, without giving a reason. You are free to withdraw at any time without consequence and your information can be removed and destroyed at your request. There are no foreseeable risks involved with participating in this study.

Your name and other personal information will never be used in any reports, presentations or publications of the study results. The Item Content Review Form uses identification numbers to keep track of participant answers to ensure confidentiality. Only the Principal Investigator will have access to the names of individuals corresponding to the codes. Completed Item Content Review Forms will be stored in a locked filing cabinet and will be destroyed within five years. Research information is the property of the Principal Investigator. Only the Principal Investigator will have access to research information for her thesis project.

If you have any questions about the study, please contact the Principal Investigator, Tricia Prodaniuk by email at or phone If you wish to speak with someone who is not involved with this study, please call Dr. Wendy Rodgers, Chair of the Faculty Ethics Committee at

I would like to have completed forms returned by XXXXX, 2003.

Sincerely,

Tricia Prodaniuk, Masters Candidate Principal Investigator	Ron Plotnikoff, PhD Associate Professor, Supervisor
Physical Education and Recreation University of Alberta, Canada Edmonton AB, T6G 2H9	Physical Education and Recreation, Centre for Health Promotion Studies University of Alberta, Canada

UNIVERSITY OF ALBERTA

Please read this consent form. You should be able to answer yes to all of the questions before proceeding. Thank-you!

Study Title: Item Content Review of a Workplace Physical Activity Scale
Principal Investigator: Tricia Prodaniuk, BPE, Masters Candidate

Do you understand that you have been asked to participate in a research study about workplace physical activity scale development?	Yes	No
Have you received and read a copy of the information letter?	Yes	No
Do you understand the benefits and the risks involved in taking part in this research study?	Yes	No
Have you had the opportunity to ask questions and discuss this study (Either through personal, telephone or email contact)?	Yes	No
Do you understand that you are free to refuse to participate, or to withdraw from this study at any time, without consequence, and that your information will be removed from the study at your request?	Yes	No
Do you understand the issue of confidentiality and do you understand who will have access to your information?	Yes	No

Consent:

***By completing the Item Content Review form and returning it to the Principal Investigator you give your consent for the data you provide to be used in this study.**

Item Content Review Form (ICRF)

Directions for experts completing the ICRF

Please rate the degree to which you feel ***each item represents*** the content descriptions (see below). Also, feel free to make any additional comments in the space provided about the relevance of the item to workplace physical activity, or the meaning interpreted from the wording of each item. These comments will be used to refine and improve these measures.

When you have rated all the items and provided any additional comments you feel necessary, please return the completed ICRF via email, fax, or by hand. If you are completing this form electronically, the best way to do this is to save this attachment as a Word document. Then, open the attachment in Word and complete the form. The file is set up as a "locked" file. To provide responses on the Likert scale, simply double click the appropriate box with your mouse arrow. A dialogue box will appear and you can indicate that you wish to check off the relevant box in the default option. An "X" should then appear in the shaded box. Additional comments can be added in the box located beneath each rating table. Once you have finished completing the form, save your document and email it back to tricia@ualberta.ca as an attached file.

Description of Content Areas

Ecological Model of a Workplace: Six different ecological levels have been identified from a Workplace Physical Activity Program Standard (Plotnikoff, Fein, & Milton, 2000). The six ecological levels are:

- **individual level:** factors in the workplace addressing individual characteristics of employees related to physical activity behaviour such as skills, knowledge, confidence, age, and gender

- **social level**: the influence of the corporate culture, social relationships, peer, and boss relationships related to physical activity behaviour of employees

- **community level**: how the workplace interacts, partners with, or utilizes other organizations, community-based resources or government bodies that may foster physical activity behaviour of employees

- **organizational level**: infrastructure, leadership, and desire of the workplace to promote physical activity, how the organization is structured

- **policy level**: the workplaces' policies regarding physical activity behaviour of employees

- **physical environment level**: the physical environment of the workplace including the buildings, workplace grounds, and surrounding area related to physical activity behaviour of employees.

Instructions

Please read the content area description before each item. Please rate each item below as to how well the item represents the content area description on the scale provided.

* IMPORTANT: The purpose of each question is to provide a single measure that represents each content area described. These items are being developed to be incorporated into research instruments to provide a global assessment of the perceived multi-level environment of the workplace with regards to physical activity. In their final form, each item would be answered on a 5 point scale from (1) "not at all" to (5) "a great amount".

1. *Individual level: factors in the workplace addressing individual characteristics of employees related to physical activity behaviour such as skills, knowledge, confidence, age, and gender*

Individual Level item:

How much information is provided in your workplace educating and/or encouraging employees about physical activity?

Poor Representation	Fair Representation	Good Representation	Very Good Representation	Excellent Representation
☐	☐	☐	☐	☐

Comments:

2. *Social level: the influence of the corporate culture, social relationships, peer, and boss relationships related to physical activity behaviour of employees*

Social Level item:

Is there a positive social climate that encourages physical activity in your workplace?

Poor Representation	Fair Representation	Good Representation	Very Good Representation	Excellent Representation
☐	☐	☐	☐	☐

Comments:

3. *Organizational level: infrastructure, leadership, and desire of the workplace to promote physical activity, how the organization is structured*

Organizational Level Item:

How much organizational capacity (i.e. infrastructure, will, and leadership) is there in your workplace that promotes physical activity for employees?

Poor Representation	Fair Representation	Good Representation	Very Good Representation	Excellent Representation
☐	☐	☐	☐	☐

Comments:

4. *Community level: how the workplace interacts, partners with, or utilizes other organizations, community-based resources or government bodies that may foster physical activity behaviour of employees*

Community Level item:

Has your organization used any services or resources in the community to support the physical activity of employees? (examples: local recreation centre, community events)

Poor Representation	Fair Representation	Good Representation	Very Good Representation	Excellent Representation
☐	☐	☐	☐	☐

Comments:

5. *Policy level: the workplaces' policies regarding physical activity behaviour of employees*

Policy Level item:

Does your workplace have policies that promote the physical activity of employees? (examples: no meetings scheduled over lunch, subsidized memberships at a fitness centre)

Poor Representation	Fair Representation	Good Representation	Very Good Representation	Excellent Representation
☐	☐	☐	☐	☐

Comments:

6. *Physical environment level: the physical environment of the workplace including the buildings, workplace grounds, and surrounding area related to physical activity behaviour of employees*

Physical Environment Level item:

Are there convenient and appropriate facilities that you can access in order to do physical activity during the workday?

Poor Representation	Fair Representation	Good Representation	Very Good Representation	Excellent Representation
☐	☐	☐	☐	☐

Comments:

Thank-you very much for your time.

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Study title: A Test Re-Test of 7 One Item Measures

Principal Investigator
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Faculty of Physical Education &
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January 10, 2003

Dear Study Participant:

Tricia Prodaniuk BPE and Masters candidate in the Faculty of Physical Education and Recreation, University of Alberta, is conducting a study under my supervision on workplace physical activity. The purpose of this study is to develop a valid and reliable measurement instrument for use in workplace physical activity research. The development of this measurement instrument will help to advance the workplace physical activity promotion field.

This study consists of a survey containing 7 short questions to be completed by workplace employees on two different occasions, two weeks apart. The information collected from the study will be used for a graduate thesis project for Ms. Tricia Prodaniuk.

Ms. Prodaniuk is seeking your participation in this important study. Your voluntary participation in this project will consist of completing seven questions at the beginning of the study and again in 2 weeks. The second questionnaire will be sent to you in two weeks through the contact person at your worksite. Your total time commitment will be approximately 15 minutes. The seven questions focus on your workplace environment(s) in relation to physical activity. Please complete the questionnaire and accompanying consent form(s) by sending the completed documents in the envelope to the contact person at your workplace. Please ensure to provide your signature on the consent form.

Your participation in this research study is voluntary and is very much appreciated. If at any time during the study you do not want to answer a question, you have the right to not answer it, without giving a reason. You are free to withdraw at any time without consequence from the study team or your employer.

If you decide to withdraw from this study after you sign up, please contact Tricia Prodaniuk by e-mail, or phone (contact information below) to ensure that you will not be sent any further correspondence, and that your information can be removed and destroyed at your request.

The benefit of participating in this study, in terms of what we hope to accomplish by conducting this survey, is information that might help employers/organizations to develop effective physical activity programs in their worksites. There are no foreseeable risks involved with participating in this study.

Your name and other personal information will never be used in any reports, presentations or publications of the study results. All information on the questionnaires will be kept confidential. The questionnaire uses identification numbers to keep track of participant answers. Completed questionnaires will be stored in a locked filing cabinet. Research information is the property of the Principal Investigator. All research information will be destroyed five years after publication. Only Tricia Prodaniuk will have access to research information for her thesis project.

If you have any questions about the study, please contact Tricia Prodaniuk by email at tricia@ualberta.ca. or phone 780-492-6315. If you have any concerns with how the study is being carried out you may also contact Wendy Rodgers PhD, Chair of the Ethics Committee, Faculty of Physical Education and Recreation (who is not directly involved with this study), University of Alberta (780) 492-5910 or email: wendy.rodgers@ualberta.ca

Thank you for your cooperation on this worthwhile project.

Sincerely,

Ronald Plotnikoff, PhD
Principal Investigator

Tricia Prodaniuk, BPE
Masters Candidate

UNIVERSITY OF ALBERTA

Please read and complete this consent form, thank you!

Study Title: A Test Re-Test of 7 One-Item Measures
Principal Investigator: Ron Plotnikoff, PhD

Do you understand that you have been asked to participate in a research study about physical activity in the workplace?	Yes	No
Have you received and read a copy of the attached information letter?	Yes	No
Do you understand the benefits and the risks involved in taking part in this research study?	Yes	No
Have you had the opportunity to ask questions and discuss this study (Either through personal, telephone or email contact)?	Yes	No
Do you understand that you are free to refuse to participate, or to withdraw from this study at any time, without consequence, and that your information will be removed from the study at your request?	Yes	No
Do you understand the issue of confidentiality and do you understand who will have access to your information?	Yes	No

Consent:

I have read the enclosed study information letter and agree to participate in this research study about physical activity in the workplace.

Signature: ____

By providing your signature you give your consent to participate in this study.

About This Study

This confidential questionnaire is about the workplace environment with regards to physical activity. There are no right or wrong answers to any of these questions. Please read the questions carefully and answer each one according to what is true for you and your place of work.

If you have any questions about the study, please contact Tricia Prodaniuk,

Confidential Contact Information of Survey Respondent:

Name: ______________________________

Organization: ____________________

Full Address (where you would like the second questionnaire sent):

____

____

____

City: ___________________ Postal Code: ______________

Phone: ________________________

Email: ________________________

Centre for
Health Promotion
STUDIES

University
of
Alberta

Faculty of Physical Education & Recreation

1. How much information is provided in your workplace educating and/or encouraging employees about physical activity?

None	A little	Some	Quite a lot	A great amount
1	2	3	4	5

2. Is there a positive social climate that encourages physical activity in your workplace?

Not at all	A little	Somewhat	Quite a lot	A great amount
1	2	3	4	5

3. How much organizational capacity (i.e. infrastructure, will, and leadership) is there in your workplace that promotes physical activity for employees?

None	A little	Some	Quite a lot	A great amount
1	2	3	4	5

4. Has your organization used any services or resources in the community to support the physical activity of employees? (examples: local recreation centre, community events)

None	A little	Some	Quite a lot	A great amount
1	2	3	4	5

5. Does your workplace have policies that promote the physical activity of employees? (examples: no meetings scheduled over lunch, subsidized memberships at a fitness centre)

Not at all	A little	Some	Quite a lot	A great amount
1	2	3	4	5

6. Are there convenient and appropriate facilities that you can access in order to do physical activity during the workday?

Not at all	A little	Some	Quite a lot	A great amount
1	2	3	4	5

7. How much do you incorporate physical activity into your workday (e.g. during breaks, active commuting to and from work)?

None	A little	Somewhat	Quite a lot	A great deal
1	2	3	4	5

UNIVERSITY OF ALBERTA

Study title: A Randomized Controlled Trial of Worksite Physical Activity Interventions in Alberta

Principle Investigator
Dr. Ron Plotnikoff
Centre for Health Promotion Studies
University of Alberta
Phone: 780-492-4372

April 30, 2002

Dear Study Participant:

I am doing a study on workplace physical activity. The purpose of my research is to develop effective, low cost physical activity education booklets for use in the workplace. The goal of these booklets is to improve the health of employees. Funding for this research is provided by the Canadian Institutes of Health Research and the Alberta Heritage Foundation for Medical Research. The study is also supported by the following employers: The City of Calgary, Capital Health Edmonton and the Northern Alberta Institute of Technology.

I am seeking volunteers at your worksite to be part of the study and encourage you to sign up. You do not have to be physically active to join. Your voluntary participation in this 14 month project will include:

1. Completing a 30 minute questionnaire in May and December of this year, and again next June '03. Questions focus on your experiences of being physically active. You may complete the questionnaires at your convenience. You are not required to do them during work hours.
2. You will be assigned into one of three groups. Two of the groups will receive booklets and information sheets throughout the study. These items are designed to help you get and stay active. A third group will receive their booklets at the end of the study.
3. At 3 months you may be phoned and asked a short question on the amount of physical activity you are getting.
4. 10% of participants will be selected at the beginning and end of the study to complete a simple fitness test. This "Step Test" takes about 10 minutes. It involves stepping up and down 3 stairs to a set pace based on age. The Step Test will be conducted by a trained fitness tester at your worksite and scheduled at your convenience.

5. 5 - 10% of participants will be asked to do a 30-45 minute interview regarding their thoughts and behaviours on physical activity at the end of the study. Interviews will be arranged at your convenience.

Your participation in this study is voluntary, and appreciated. If at any time you do not want to answer a question, you have the right to not answer it without giving a reason. You are free to withdraw at any time without consequence from the study team or your employer.

Benefits of being in this study may include getting and staying more physically active. Receiving the questionnaire alone may remind you to think about being active. There are no known risks involved with participating in this study. Some people may feel a lack of confidence if they do not become more active during the course of the study.

Your name and other personal information will never be used in presentations or publications of the results. All returned questionnaires are kept confidential. Identification numbers are used to keep track of participant answers. Completed questionnaires will be stored in a locked filing cabinet. Research information is the property of the Principal Investigator. Information from those who withdraw is kept, but not used in the data analysis. All research information will be destroyed after five years. Only the study team will have access to the study files. All information will be held private, except when professional codes of ethics or the law requires reporting.

Please complete the questionnaire and return it in the enclosed envelope. We'll provide you a summary of your physical activity results and the study's overall results at the end of the project. Final results will be provided to the employers together with education workshops at the end of the project.

If you have any questions about the study, please contact Marie Carlson, Project Coordinator at (780) 492-8905 or email: marie.carlson@ualberta.ca. If you have any concerns with how the study is being carried out you may also contact Wendy Rodgers PhD, Associate Dean, Research, Faculty of Physical Education and Recreation, University of Alberta (780) 492-5910 or email: wendy.rodgers@ualberta.ca.

Thank you for your cooperation on this worthwhile project.

Sincerely,

Ronald Plotnikoff, PhD Principal Investigator	Tricia Prodaniuk, BPE Graduate Research Assistant

Study Co-Investigators:

Kerry Courneya PhD (780) 492-1031 & John Spence PhD (780) 492-1379, University of Alberta
Nicholas Birkett MD, (613) 562-5800, University of Ottawa
Bess Marcus PhD, (401) 793-8176, Brown University, Rhode Island NY

UNIVERSITY OF ALBERTA

Please read and complete both copies, keep one for your information and return the second copy with your completed questionnaire, thank you!

Study Title: A Randomized Controlled Trial of Physical Activity Interventions in Alberta
Principal Investigator: Ronald Plotnikoff, PhD (780) 492-4372
Co-Investigators:
Kerry Courneya PhD (780) 492-1031 & John Spence PhD (780) 492-1379, University of Alberta
Nicholas Birkett MD, (613) 562-5800, University of Ottawa
Bess Marcus PhD, (401) 793-8176, Brown University, Rhode Island NY

To be completed by the Workplace Environment Survey Respondent:

Do you understand that you have been asked to participate in a research study about physical activity interventions in the workplace?	Yes	No
Have you received and read a copy of the attached information letter?	Yes	No
Do you understand the benefits and the risks involved in taking part in this research study?	Yes	No
Have you had the opportunity to ask questions and discuss this study (Either through personal, telephone or email contact)?	Yes	No
Do you understand that you are free to refuse to participate, or to withdraw from this study at any time, without consequence, and that your information will be withdrawn at your request?	Yes	No
From the information letter, do you understand the issue of confidentiality and do you understand who will have access to your information?	Yes	No

Please continue on the other side . . .

Signatures:

I have read the enclosed study information letter and agree to participate in this research study about physical activity interventions in the workplace.

________________________	________________	____________
Participant Name, please print	*Participant Signature*	*Date*
________________________	________________	____________
Witness Name, *please print*	Witness Signature	Date

Confidential Contact Information of Workplace Environment Survey Respondent:

Name: __________________ Position: ______________________

Organization: _______________ Contact Phone Numbers:______________

Full Work Address (including room number, internal mail code, unit, building number or locator):

____

____

____

City: ______________________ Postal Code: ________________

Email: ____

Social Cognitive Measures

The next questions ask how confident you are about doing regular physical activity in different circumstances. Please circle one response for each question.

In the next 6 months, I am confident that I can participate in regular physical activity:

	Not at all confident	*Not very confident*	*Moderately confident*	*Very confident*	*Extremely confident*
1. When I am a little tired.	1	2	3	4	5
2. When I am in a bad mood or feeling depressed.	1	2	3	4	5
3. When I have to do it by myself.	1	2	3	4	5
4. When it becomes boring.	1	2	3	4	5
5. When I can't notice any improvements in my fitness.	1	2	3	4	5
6. When I have many other demands on my time.	1	2	3	4	5
7. When I feel a little stiff or sore.	1	2	3	4	5
8. When the weather	1	2	3	4	5

is bad.

9. When I feel a little ill.	1	2	3	4	5

To what extent will the following ideas influence your decision to do regular physical activity over the next 6 months?

*Remember, we are not asking you how much you agree or disagree with these statements, but rather how much each may influence your decision to do regular physical activity over the **next 6 months**.*

Over the next 6 months:	***Not at all***	***A little***	***Somewhat***	***Quite a lot***	***Very much***
1. Physical activity would help me reduce tension or manage stress.	1	2	3	4	5
2. I would feel more confident about my health by getting regular physical activity.	1	2	3	4	5
3. I would sleep better.	1	2	3	4	5
4. Physical activity would take too much of my time.	1	2	3	4	5
5. I would have less time for my family and friends if I participated in physical activity.	1	2	3	4	5
6. I'd be too tired to get physical activity because of my other daily responsibilities.	1	2	3	4	5
7. Physical activity would help me have a more positive outlook.	1	2	3	4	5

Remember, we are not asking you how much you agree or disagree with these statements, but rather how much each may influence your decision to do regular physical activity over the next 6 months.

8.	Physical activity would help me control my weight.	1	2	3	4	5
9.	I'd worry about looking awkward if others saw me being physically active.	1	2	3	4	5
10.	Participating in physical activity would cost too much money.	1	2	3	4	5
11.	Regular physical activity would cause me injury.	1	2	3	4	5

Godin Instrument: Measure of Leisure Time Physical Activity Behaviour

For this question, we would like you to recall your average weekly participation in physical activity over the past month. How many times per week on average did you do the following kinds of physical activity during your free time over the past month?

When answering these questions please:

- Consider your average over the past month.
- Only count physical activity sessions that lasted 10 minutes or longer in duration.
- Do not count physical activity that was done as part of your employment or household chores.
- Note that the main difference between the three categories below is the intensity of the physical activity.
- Please write the average amount of times per week for strenuous, moderate, and mild physical activity.

	Times Per Week
A. Strenuous physical activity (heart beats rapidly, sweating) (e.g., running, jogging, hockey, soccer, squash, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, heavy weight training)	
B. Moderate physical activity (not exhausting, light perspiration) (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	
C. Mild physical activity (minimal effort, no perspiration) (e.g., easy walking, yoga, archery, fishing, bowling	

Workday physical activity assessment:

How much do you incorporate physical activity into your workday (e.g. during breaks, active commuting to and from work)?

None	***A little***	***Somewhat***	***Quite a lot***	***A great deal***
1	2	3	4	5